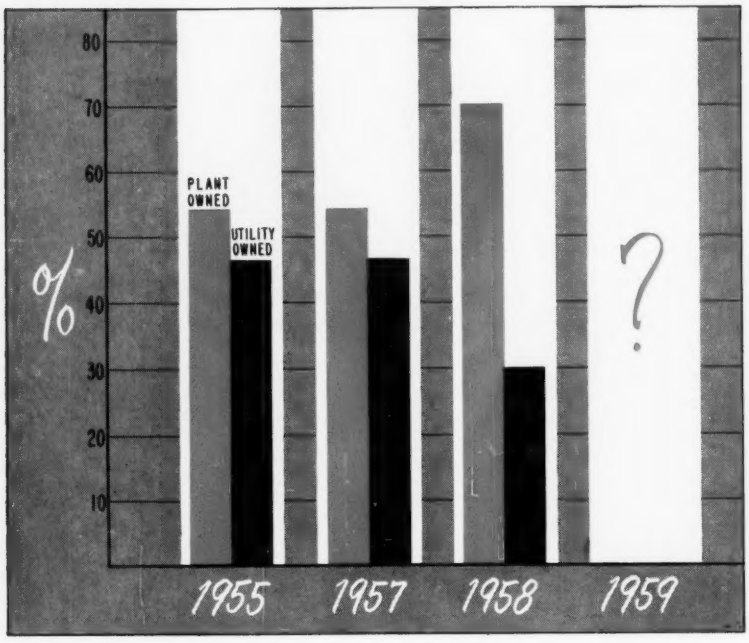
For engineers who design and manage the power and plant services

Power

FEBRUARY 1959

ONE DOLLAR

A McGRAW-HILL PUBLICATION



PRIMARY SUBSTATIONS:
Will more industrials choose self-ownership? . . . 66

▶ Piping layouts where welding pays . . . 64

▶ Stainless fares well on heat transfer . . . 75

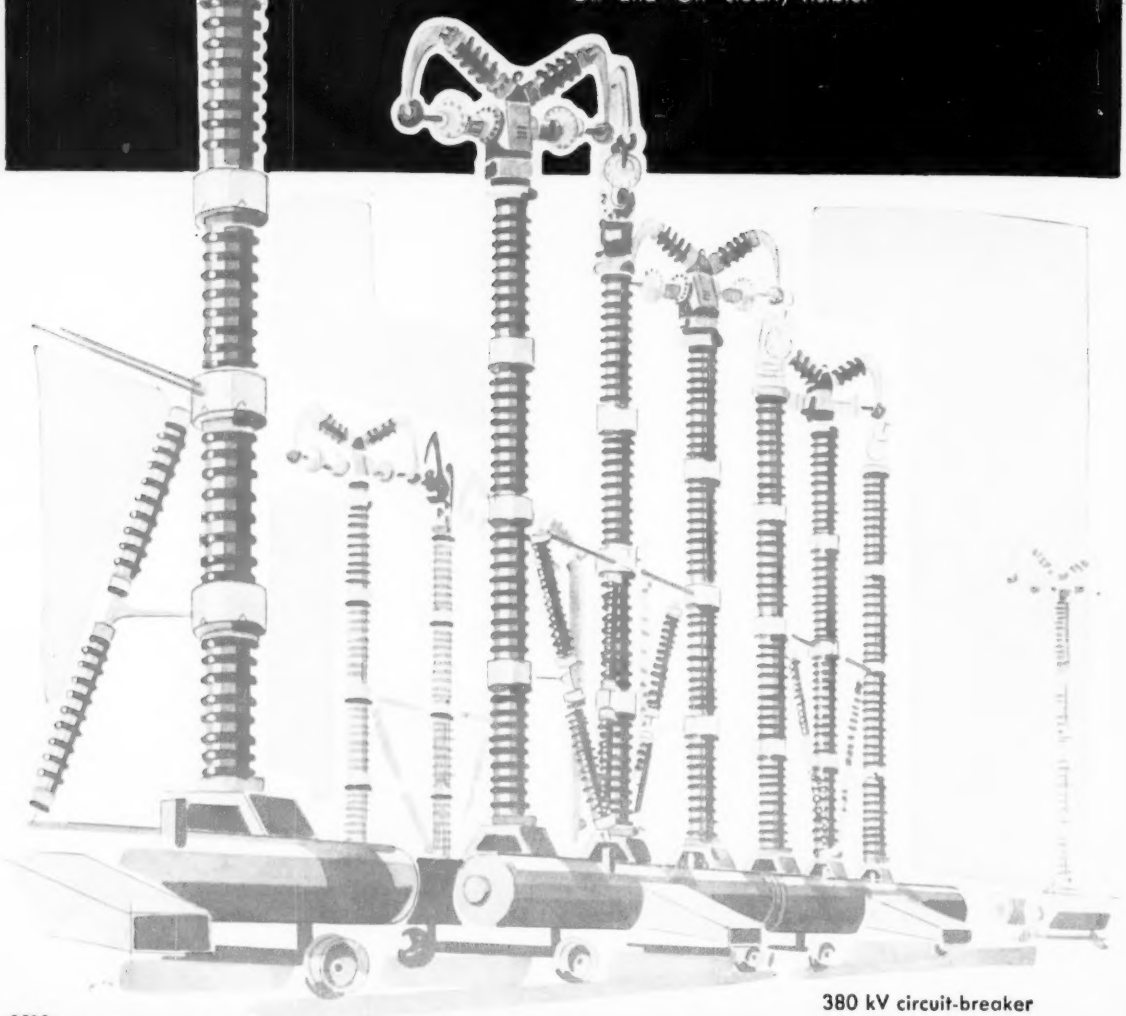
▶ How Memphis trains power men . . . 189

Generating electricity a TD report . . . 55

AEG

High-Tension Switchgear

AEG Multiple free-jet air-blast
circuit-breakers up to highest ratings.
Unfailing in service.
Compressed-air operated.
"On" and "Off" clearly visible.



380 kV circuit-breaker

8535e

ALLGEMEINE ELEKTRICITÄTS-GESELLSCHAFT

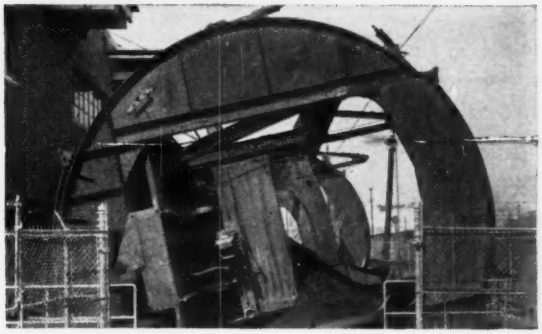
Berlin (West) EXPORT DEPARTMENT Frankfurt (Main)

For more facts circle 201 on Reader Service Card, p 102

LINK-BELT equipment

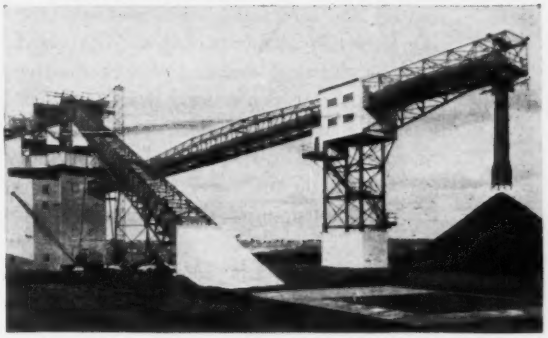
leads the way to lowest cost-per-ton coal handling

UNLOADING



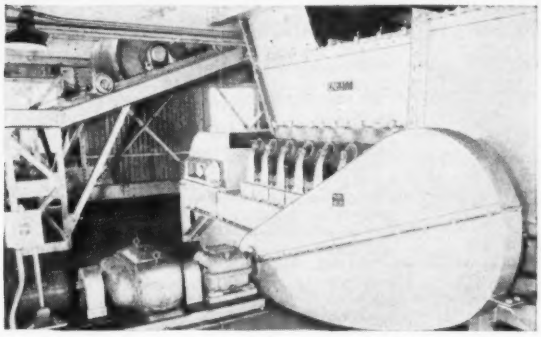
ROTARY DUMPERS provide rapid, economical unloading of all types of open-top cars up to ninety-ton capacity. They empty the load thoroughly, even if coal is moist, fine or frozen.

RECLAIMING



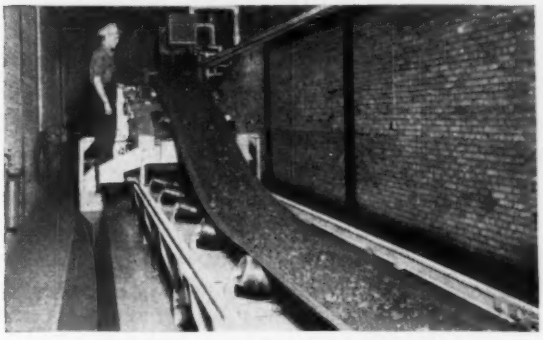
HIGH-CAPACITY RECLAIMING is obtained with independent system of hoppers, feeders and conveyors which assure fast, efficient, economical transfer of coal from storage to bunkers.

FEEDING



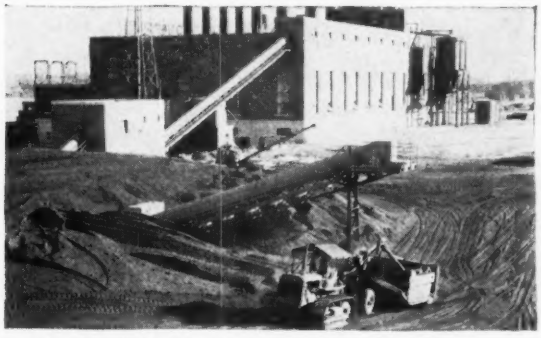
FEEDERS move coal from receiving hopper. Line includes belt (above), apron, screw, vibrating and other types. Link-Belt also makes a complete line of mechanical power transmission products.

DISTRIBUTING



BELT CONVEYORS transport large tonnages quickly and at low cost . . . stock out, reclaim, distribute. When distributing coal to bunkers, plow on tripper and bin seal, confine dust.

STORING



STORAGE SYSTEMS for any capacity can be designed, equipped and installed by Link-Belt. At small power plants, Link-Belt elevators, silos and conveyors for reclaiming provide low-cost storage.

IN public utility power plants . . . in commercial, industrial and institutional boiler houses — wherever power, heat or steam for processing is produced by coal, Link-Belt can recommend the right methods and equipment to achieve lowest per-ton handling costs.

Find out how this *one-source* service can improve *your* coal handling procedures. Link-Belt will work with your engineers and consultants from planning through erection of your system . . . or can assume complete responsibility for the entire installation. Contact your nearest Link-Belt office for complete information. Ask for Book 2410.

LINK-BELT

COAL HANDLING EQUIPMENT

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Australia, Marrickville (Sydney); Brazil, Sao Paulo; Canada, Scarboro (Toronto 13); South Africa, Springs. Representatives Throughout the World. 14,593

For more facts circle 204 on Reader Service Card, p 102

speaking of **Power**

February 1954 saw newspaper reporters tapping out stories on the much talked about "atomic" battery and speculating on tomorrow's power coming from tidy atomic packages. What stirred them was the electrical coupling of a radioactive source to a transistor-like wafer. Result: an instant release of some 200,000 electrons for each beta particle received (POWER, April 1954). This step was but another in the many efforts to produce electricity, sidestepping the prime mover-rotating generator technique.

Generating electric energy by collecting beta particles was not new, even then. In 1913 Britain's H G J Mosley produced a high voltage by collecting beta particles from radium in a vacuum. Today we still have many of the time honored ways plus a raft of new ones for producing usable electricity.

This month's *TD* report, starting on p 55, wraps up the latest thinking in this growing field. Associate Editor Ben Skrotzki gives perspective to some 15 ways for getting an electron flow.

Trend spotting ability, even the sensing of a possible shift in current practice, is one mark of a top-drawer editor. It calls for uncovering, understanding and interpreting the engineering facts.

An illustration of trend anticipation, if you will, may be found in this month's Power-to-grow . . . *electrically* article, p 66, concerning ownership of industrial plant primary substations. From a limited sampling we detect much interest by industrials in assuming full ownership.

Staffer Norm Peach has been promoted from assistant to associate editor. In his new capacity Norm will assume an even greater responsibility in expanding POWER's coverage within the broad field of electrical power engineering.

Lou Rowley

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In Power this month

FEBRUARY 1959 • VOL. 103 • NO. 2 • 77TH YEAR

Editorial: Where do we go from here? 51

DESIGN AND EQUIPMENT APPLICATION

A *TD* report: More ways to generate electricity 55
Planning ahead gives Dayton Power & Light a topnotch ash-handling system 61
Design your piping layout to take advantage of welded fittings or bends 64
Primary-sub ownership: No. 17 in the Power-to-grow . . . *electrically* series 66
What you should know about plotting mechanical-drive turbine performance 69
Save time and cut costs with cable troughs and ladders 72
Condenser tube tests show high heat transfer for stainless steel 75

DEPARTMENTS

Nuclear notes: News briefs on the latest developments 80
Comment: Two pages reserved for readers' remarks 82
Data sheet: Hydrostatic head for liquids 86
Technical briefs: Digests of latest engineering papers for busy power men 94
New literature: Yours simply for mailing postage-free Reader Service Card 101
Equipment design of the month: Two radome cooling units ready for industry 114
Plant equipment news: Your information center of new products and materials 116
Thermo refresher: Flowing fluids do strange tricks 144
Marmaduke Surfaceblow resurrects a broken-down diesel engine 150
Powerscope: A selective look at this month's power-field happenings 164
Reports from the field 167 *Calendar of events* 168
Appointments 178 *Engineers' bookshelf* 182
George *Edwards* points up the seat of a lot of trouble 186

PLANT MAINTENANCE AND MANAGEMENT

Memphis utility tackles power training to run new plant efficiently 189
Operators' notebook: Seal your h-t h-p joints with this missile coupling 192
Why your chimney needs first-class maintenance 194
Desludging i-c engines without dismantling saves maintenance dollars 196
Do you know how to get clean, dry compressed air? 198
Plant electrical fact file: Six tips on trouble shooting induction motors 200
Plant problems: Here's how *Power* readers would tackle them 202
Practical ideas to keep your plant running at peak efficiency 206

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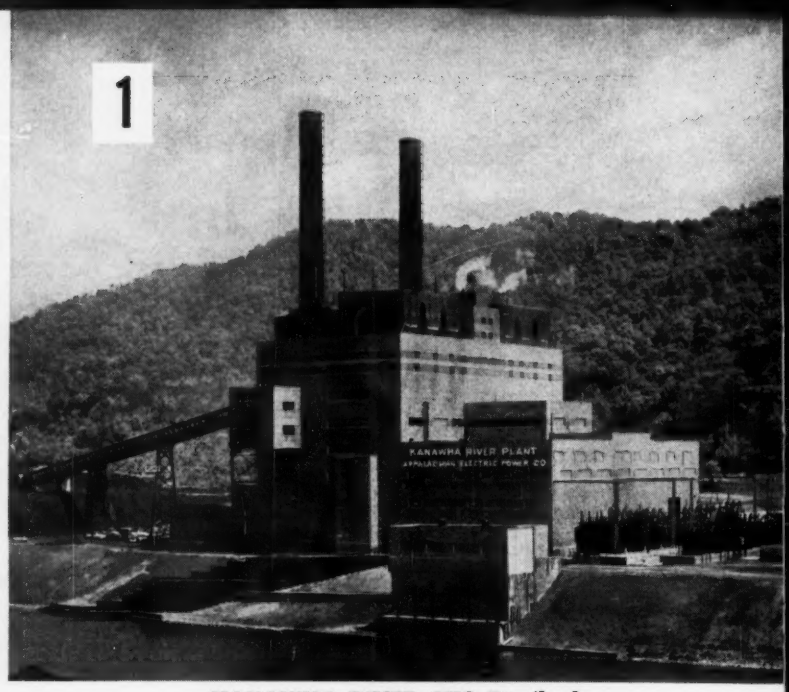
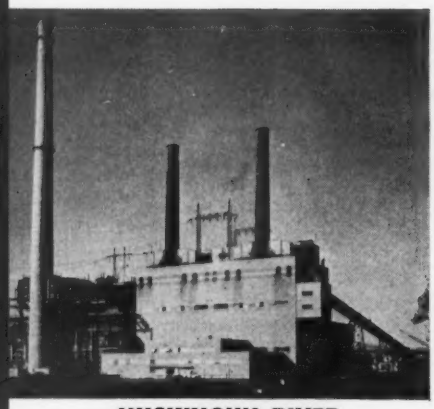
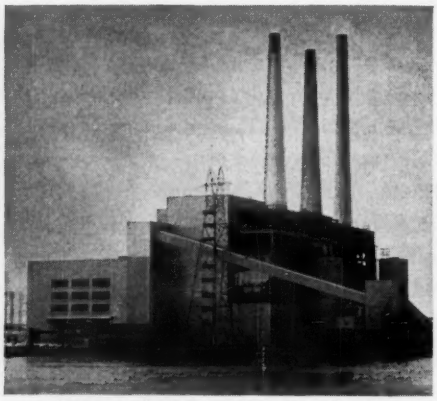


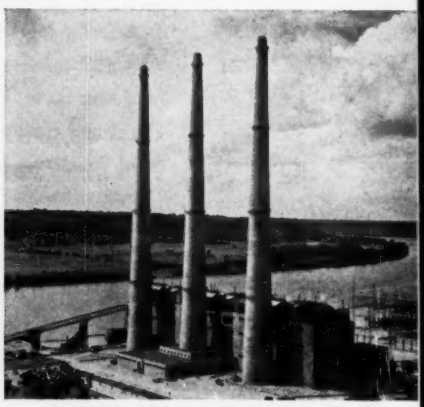
KANAWHA RIVER 9118 Btu/kwhr
Appalachian Power Co. on the American Electric Power System
Two B&W Pressure-Fired Radiant Boilers



MUSKINGUM RIVER
9139 Btu/kwhr Ohio Power Co.
on the American Electric Power System
Two B&W Pressure-Fired Open-Pass Boilers and one Pressure-Fired Radiant Boiler

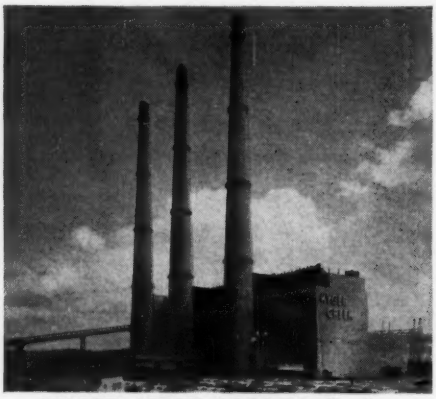


RIVER ROUGE 9140 Btu/kwhr
Detroit Edison Co.
One B&W Radiant Boiler
Firing 10% Blast Furnace Gas and 90% Coal

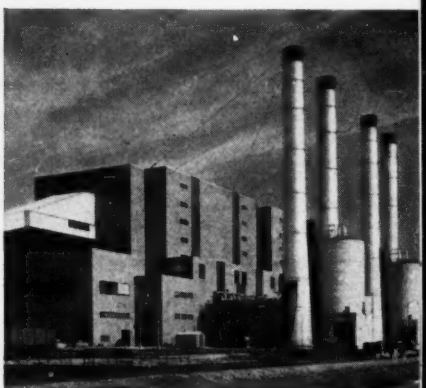


CLIFTY CREEK 9147 Btu/kwhr
Indiana-Kentucky Electric Corporation*
Six B&W Pressure-Fired Open-Pass Boilers

TANNERS CREEK 9180 Btu/kwhr
Indiana & Michigan Electric Co.
Power System on the American Electric
Three B&W Pressure-Fired Radiant Boilers



KYGER CREEK 9201 Btu/kwhr
Ohio Valley Electric Corporation*
Five B&W Pressure-Fired Open-Pass Boilers



ST. CLAIR 9210 Btu/kwhr
Detroit Edison Co.
Four B&W Radiant Boilers

BAY SHORE 9210 Btu/kwhr
Toledo Edison Co.
One B&W Radiant Boiler

ALLEN 9349 Btu/kwhr
Duke Power Co.

JOHN SEVIER 9350 Btu/kwhr
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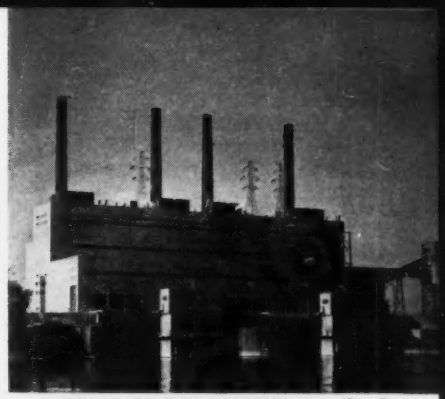
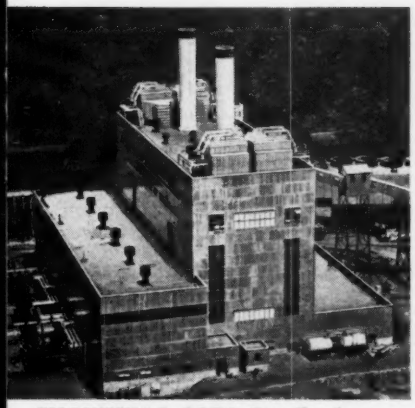
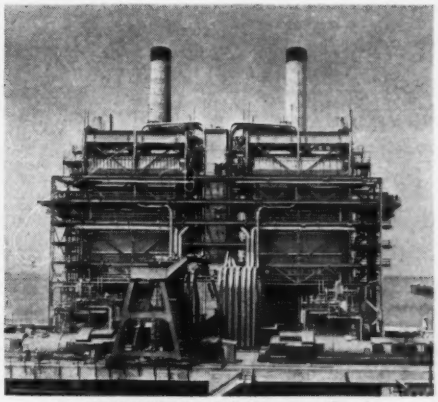
MILLIKEN 9371 Btu/kwhr
New York State Electric & Gas Corporation



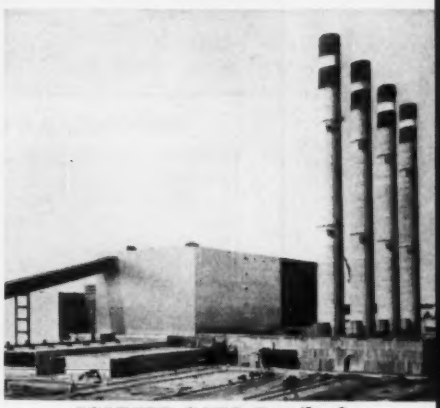
PHILIP SPORN 9370 Btu/kwhr
Appalachian Power Co. and Ohio Power Co.
on the American Electric Power System
Four B&W Pressure-Fired Radiant Boilers



SHAWVILLE 9396 Btu/kwhr
Pennsylvania Electric Co.
Two B&W Radiant Boilers



EL SEGUNDO 9467 Btu/kwhr
Southern California Edison Co.
One B&W Radiant Boiler



COLBERT 9470 Btu/kwhr
Tennessee Valley Authority
Four B&W Radiant Boilers

B&W Boilers Help Put 12 Power Plants Among Top 15 Most Efficient in Nation . . .

Outstanding proof that B&W engineering developments lead the way to reliable, economical power production

Of the 15 most efficient power plants in the United States as reported by the Federal Power Commission, 12 have B&W Boilers. Why? Because B&W's major investment in engineering research and development has led to great strides in power plant efficiency.

B&W is working with the Power Industry to keep electricity America's best bargain despite rising fuel and operating costs. Right now, B&W is investing millions of dollars in improved products—such as the Universal Pressure Boiler—in the better utilization of low grade fuels, basic metallurgical research for higher temperatures. In this way, B&W is helping America's utilities meet increased demands for abundant, economical electricity.

The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

G-901-CS

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[a]Subsidiary of American Electric Power Co. [b]Subsidiary of The West Penn Electric Co. [c]Subsidiary of Ohio Edison Co.

BABCOCK & WILCOX
BOILER DIVISION

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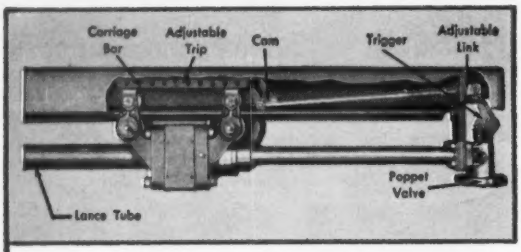
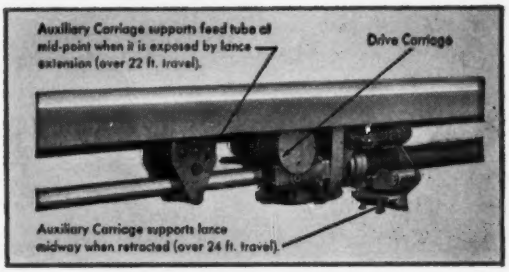
Reasons FOR THE ENTHUSIASTIC ACCEPTANCE



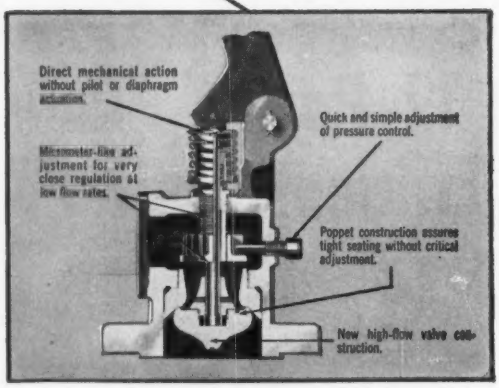
MECHANICALLY OPERATED VALVE

Control of blowing medium is automatic, positive and accurate by means of a simple, dependable mechanically operated valve. As lance begins movement into boiler, trip on carriage opens valve through a linkage. At end of retraction, trip closes valve. All pilot or diaphragm valve elements are eliminated. Trip is adjustable.


Auxiliary Carriage supports feed tube at mid-point when it is exposed by lance extension (over 22 ft. travel).
Drive Carriage
Auxiliary Carriage supports lance midway when retracted (over 24 ft. travel).

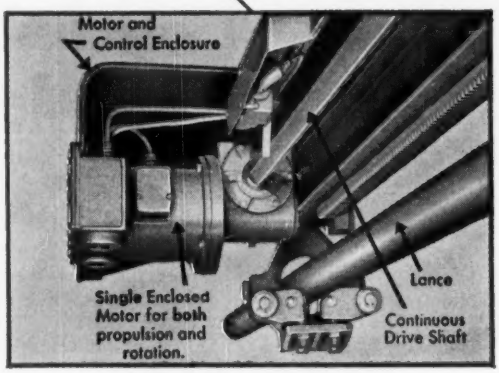
AUXILIARY CARRIAGES (FOR EXTRA LONG TRAVEL)

On extra long blowers, one auxiliary carriage supports lance midway when retracted, preventing undue bending. Second auxiliary carriage is dropped at mid-point to support feed tube when it is exposed by lance extension.


Direct mechanical action without pilot or diaphragm actuation.
Micrometer-like adjustment for very close regulation at low flow rates.
Quick and simple adjustment of pressure control.
Poppet construction assures tight seating without critical adjustment.
New high-flow valve construction.

POPPET VALVE WITH ADJUSTABLE PRESSURE CONTROL

Diamond dependable poppet valve with improved streamlined flow contours and adjustable pressure control that permits easy, accurate setting of pressure at individual valve and independent of other blowers. Poppet construction assures tight seating without critical adjustment. Stem, seat and disc are stainless steel. Stellited seating surfaces are available.



STATIONARY GEAR MOTOR

Lance propulsion and rotation are by a *single* enclosed gear motor which drives a continuous shaft running the full length of blower and providing power to carriage. This construction makes it possible to mount motor in a fixed position at the front end for better protection and accessibility.

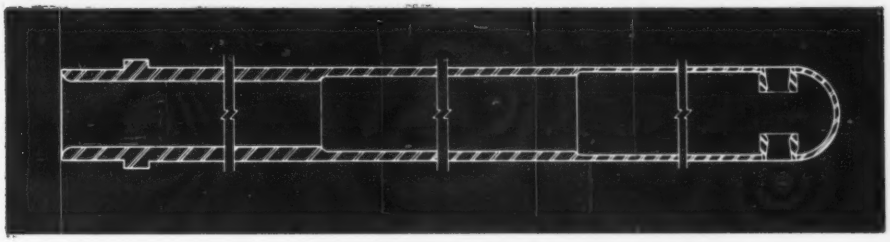
8077

DIAMOND POWER

of the DIAMOND SERIES 300 IK
LONG RETRACTING BLOWER

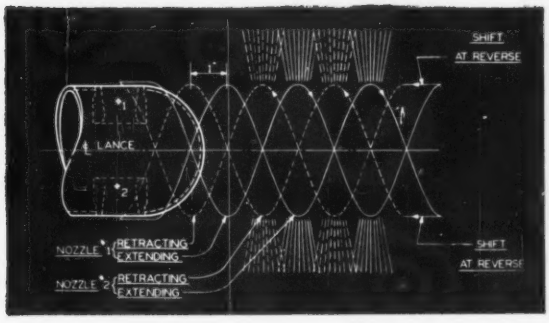
The Diamond Series 300 IK Blower sets a new and higher standard of efficiency, economy and dependability in the cleaning of heating surfaces that require a long retracting lance type blower. Pointed out in detail are some of its important features. Others are a *single* outboard support point to simplify installation and the attractive "backbone" cover for greater rigidity and protection of the entire blower assembly from dirt, damage, the elements and personnel hazards.

This new Series 300 IK is the culmination of more than 20 years' experience building and applying long travel blowers. It well illustrates the Diamond design philosophy: *"Keep it simple . . . keep it basic . . . avoid unnecessary complications."* It is further evidence of the fact that YOU CLEAN BOILERS BETTER AND AT LOWER COST WITH DIAMOND BLOWERS.



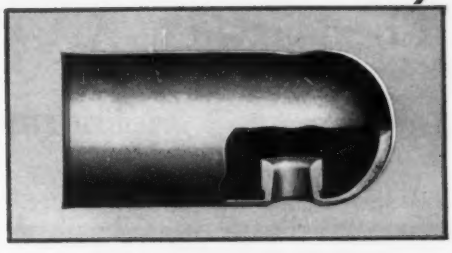
STEP-TAPER LANCE
(FOR EXTRA LONG TRAVEL)

Extra long lance has minimum droop due to step-taper construction which employs up to four different wall thicknesses. Lightest wall is at nozzle end to reduce bending moment. Lance is chrome alloy for heat resistance.



IMPROVE CLEANING PATTERN

Close and positively controlled helical cleaning pattern assures maximum cleaning effectiveness. Blowing pattern diagram illustrates how return travel path is exactly intermediate with forward travel path so that there is a *positive nozzle sweep every inch.*



IMPROVED DIAMOND NOZZLE

New design Diamond "Type A" Nozzle is the result of several years' research and the testing of more than 50 different contours. The modified venturi produces maximum impact pressure and cleaning effectiveness with minimum expenditure of cleaning medium. (Steam or compressed air.)

For further information, ask the nearest Diamond office or write directly to Lancaster for Bulletin 2111U.

SPECIALTY CORP. **LANCASTER, OHIO**
DIAMOND SPECIALTY LIMITED—Windsor, Ontario

For more facts circle 206 on Reader Service Card, p 102

Now! Ready-to-install in a single package—

- **High-temperature insulation**
- **A protective metal jacket**
- **A built-in vapor barrier**

The insulation in Metal-On is Johns-Manville Thermobestos® . . . finest of all the calcium silicate insulations for service to 1200°F.

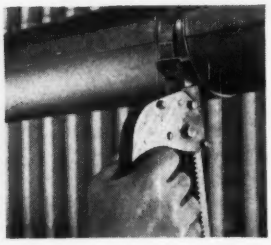
From carton to

. . . with

Thermobestos calcium silicate insulation

5 SECONDS TO REMOVE Metal-On from carton. Another 25 seconds to snap on pipe and lock in place!

15 SECONDS LATER the specially designed aluminum "snap strap" (containing vapor seal) has been snapped on joint.



METAL BAND provides perfect joint protection against vapor and weather. Total elapsed time: 90 seconds!

Here's the fastest, most efficient way ever to install high-temperature pipe insulation and protective aluminum jacketing.

Metal-On is the insulation idea all industry has asked for: a single package product that permits application of Thermobestos pipe insulation and corrosion-resistant metal jacket in one fast operation. You'll find that a section of Metal-On can be applied as fast as, oftentimes faster than, an insulation alone.

Snaps in place . . . F-A-S-T!

J-M's new Metal-On consists of Thermobestos calcium silicate insu-

Metal-On ends jacket thickness and alloy guesswork! The Metal-On jacket measures an ideal .016-inch thick . . . of a high-quality aluminum alloy selected for superior weather resistance.

pipe in 90 seconds!

new J-M METAL-ON Insulation!

factory-jacketed in gleaming, weatherproof aluminum

lation, a vapor barrier and an all-weather protective covering of aluminum. Furnished ready-to-install, a section of Metal-On snaps on the pipe, locks tightly in place (new locking device is exclusive Metal-On feature) to seal out weather and protect the insulation indefinitely. Joints are sealed tight with aluminum "snap straps" mechanically fastened in place with metal bands.

Right alloy . . . proper thickness

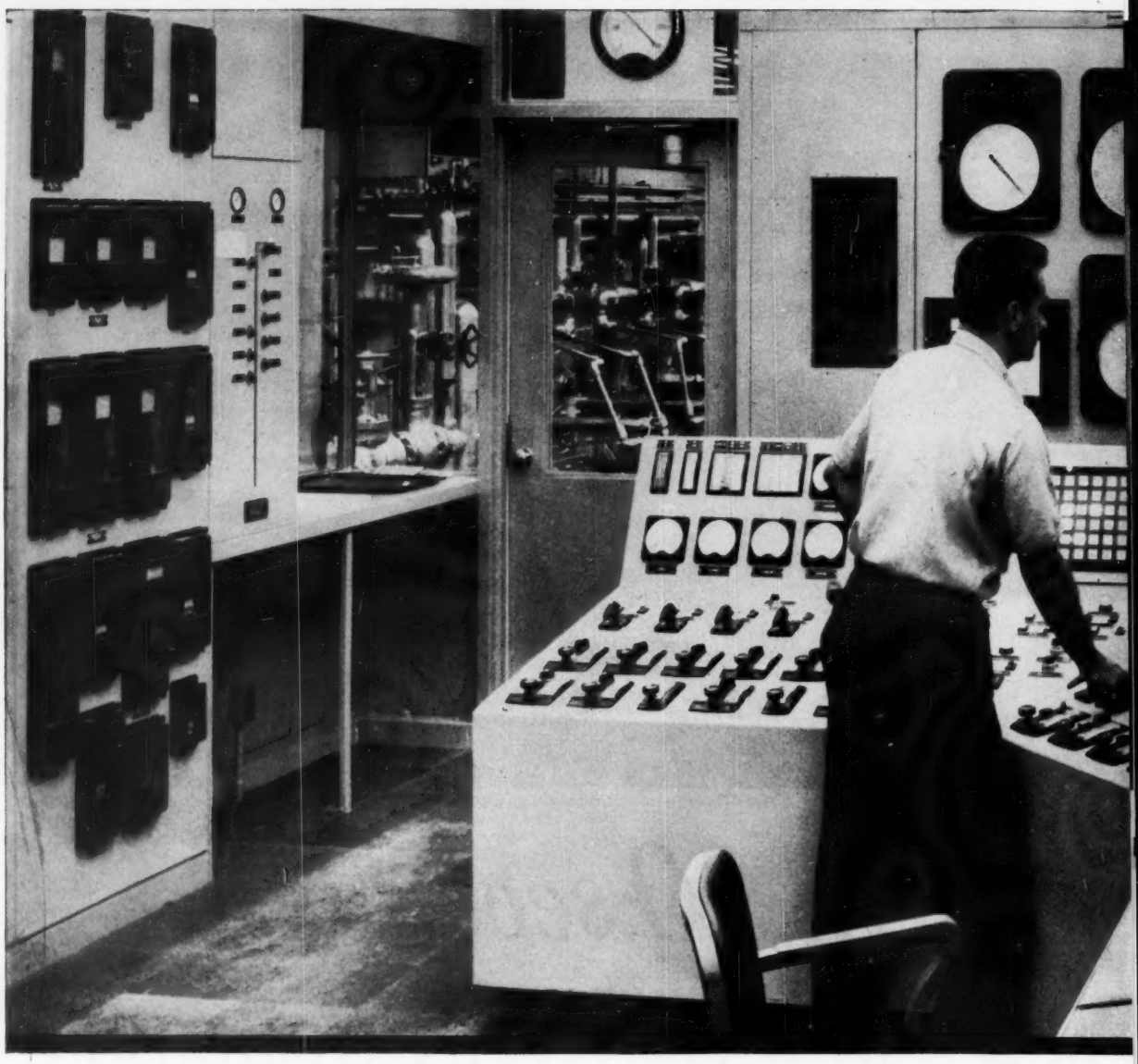
The Metal-On aluminum jacket reduces maintenance in virtually every outdoor pipe application! It never needs painting . . . won't rust . . . is impervious to surface dirt, oils and grime. The jacketing is made of an aluminum alloy (containing magnesium) that is specially selected for superior corrosion resistance. Jacket thickness is designed to provide, at lowest cost, outstanding appearance, stiffness, workability and resistance to abuse and pitting.

Metal-On presents no fitting problem. It is cut easily right on the job with either power or hack saws. Available in 36″ sections in a complete range of pipe sizes through 24″ . . . by 3″ thickness.

To help you investigate Metal-On for your next pipe insulation requirement, let us send you the informative brochure, IN-217A. Write for it today. Address Johns-Manville, Box 14, New York 16, N.Y. In Canada, Port Credit, Ontario.

JOHNS-MANVILLE JOHNS-MANVILLE JM PRODUCTS

For more facts circle 207 on Reader Service Card, p 102



How Bailey stretches

You can wring more energy out of a dollar's worth of fuel when you are getting optimum performance from your steam plant equipment. You get peak performance when Bailey Meters and Controls are on the job. They increase your plant efficiency.

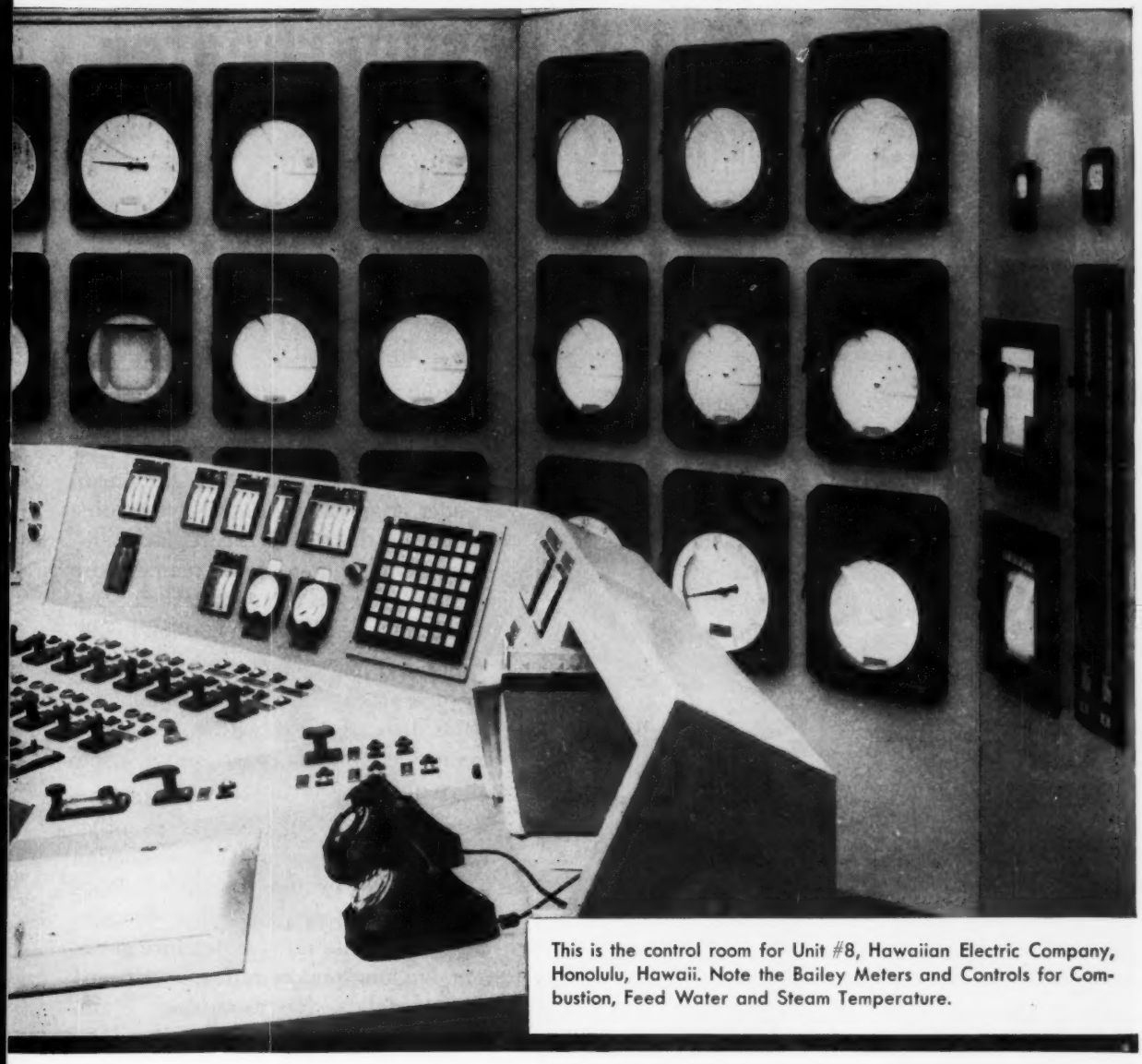
Bailey is the choice of virtually all the most efficient plants on the Federal Power Commission's heat rate report. Here's why:

1. A Complete Line of Equipment

You can be sure a Bailey Engineer will offer the right combination of equipment to fit your needs. Bailey manufactures a complete line of standard, compatible pneumatic and electric metering and control equipment that has proved itself. Thousands of successful installations involving problems in measurement, combustion, and automatic control are your assurance of the best possible system.

2. Experience

Bailey Engineers have been making steam plants work more efficiently for more than forty years. Veteran engineer and young engineer alike, the men



This is the control room for Unit #8, Hawaiian Electric Company, Honolulu, Hawaii. Note the Bailey Meters and Controls for Combustion, Feed Water and Steam Temperature.

your fuel dollar

who represent Bailey, are storehouses of knowledge on measurement and control. They are up-to-the-minute on the latest developments that can be applied to your problem.

3. Sales and Service Convenient to You

There's a Bailey District Office or Resident Engineer close to you. Check your phone book for expert engineering counsel on your steam plant control problems.

A132-2

BAILEY METERS

Instruments and controls for power and process

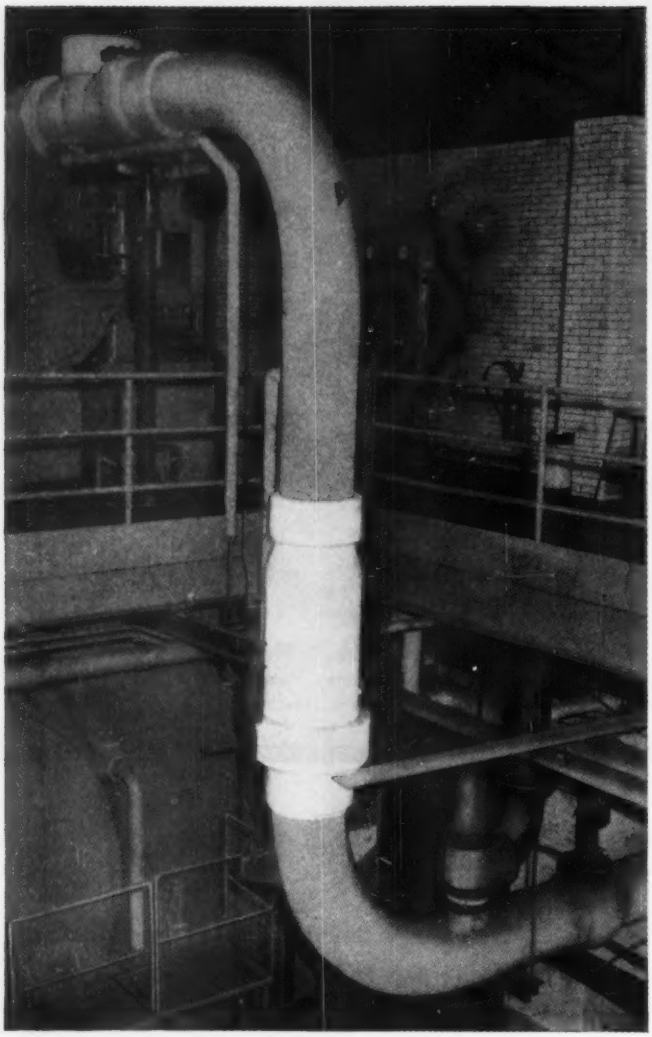
BAILEY METER COMPANY

1036 IVANHOE ROAD • CLEVELAND 10, OHIO

In Canada—Bailey Meter Company Limited, Montreal

For more facts circle 208 on Reader Service Card, p 102

New Copes-Vulcan Desuperheater handles critical job at Pennsylvania Electric Company



Copes-Vulcan's newly developed Variable-Orifice Desuperheater provides precise temperature control at Pennsylvania Electric Company's Front Street Station. Installed in the steam header supplying a 12,500-kw turbine generator, this desuperheater has maintained a discharge steam temperature of 490 FFT even though inlet temperature has varied between 600° and 650°.

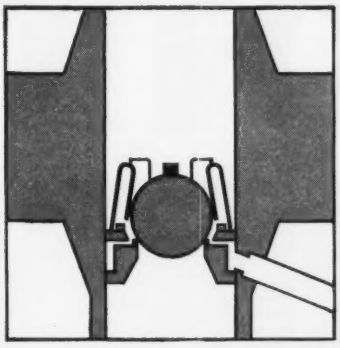
Located just 20 feet upstream of the turbine throttle this desuperheater holds temperatures within a plus or minus 3F limits, consistently meets all required pressure conditions.

Advance design pays off in other ways, too. Only one outside connection —for cooling water—is needed. With only one moving part, this desuperheater presents no maintenance problem. No long runs of piping are needed to mix fluids. No atomizing steam, spray nozzle or glands are required.

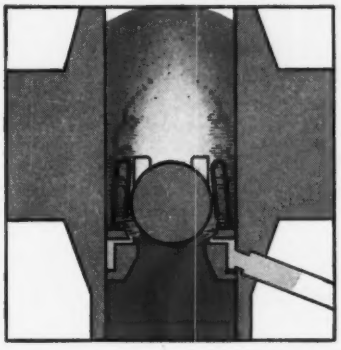
Copes-Vulcan designs a complete line of desuperheaters, each type engineered to meet particular operating conditions. For complete details on the Variable-Orifice Desuperheater, write for Bulletin 1037.

Copes-Vulcan Division
BLAW-KNOX COMPANY
Erie 4, Pennsylvania

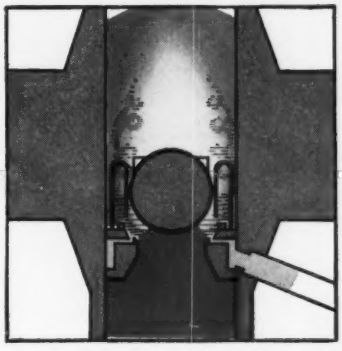
SIMPLE PRINCIPLE OF OPERATION



No load: Ball has seated itself on the ring. There is no flow of steam—no flow of cooling water.

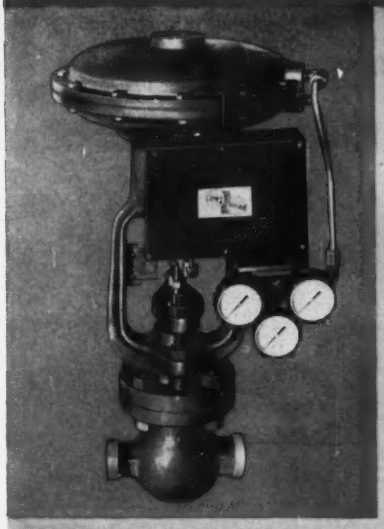


Light load: Ball opens orifice slightly. Cooling water is instantly and intimately mixed with steam.



Full load: Orifice fully opened. There is the same pressure drop and high turbulence at all loads over the full range.

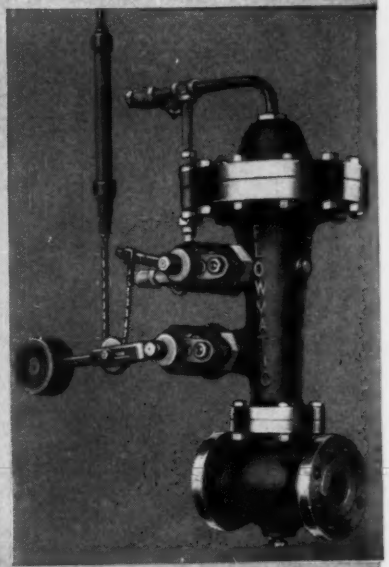
C-V NEWS NOTES



A Type CV-D Pressure reducing valve is used at Front Street Station to automatically regulate the cooling water supplied from the feed-water-heater.

This Copes-Vulcan diaphragm valve is designed to dependably meet rigid standards of accuracy for pressure, temperature and liquid level control. The Type CV-D may be direct or reverse acting. Rangeability is excellent.

Style and area of valve ports are scientifically selected to meet specified operating conditions. These versatile valves can be applied in sizes up to 12 inches in pressure—standards up to 1500 pounds. For details on Copes-Vulcan valves, write for Bulletin 1027.



For modern feed water control: The Copes Flowmatic, a two-element feed water regulator, is sensitive to the slightest change in steaming rate, and to the most minute fluctuation of boiler water level.

Closer stabilization of boiler water level under all load conditions makes the Copes Flowmatic ideal for the modern utility and industrial boilers subject to rapid, wide fluctuations in steam demands.

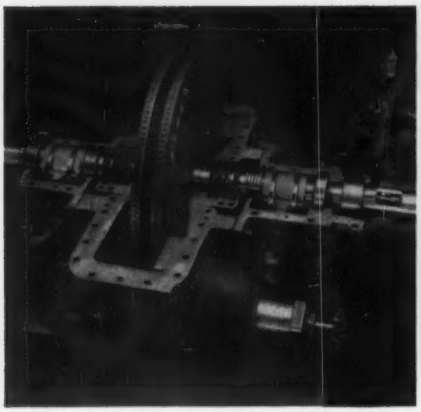
With the direct-operated Flowmatic Regulator (shown above) the steam flow element is built integral with the valve bonnet. In regular service outdoors, the Flowmatic Type D-O is unaffected by atmospheric conditions, provides accurate, dependable performance. For further information, write for Bulletin 1003-A.

For more facts circle 209 on Reader Service Card, p 102

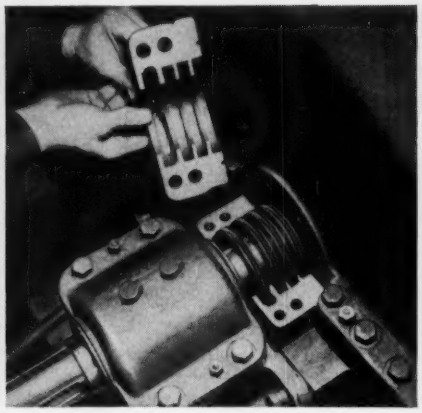
Economical in operation...

Dependable always

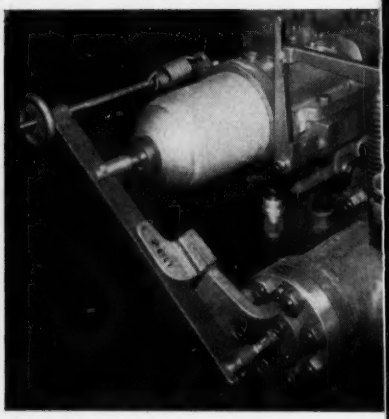
ELLIOTT



Precise alignment of shaft, through true centerline support, permits smooth and dependable operation at all operating temperatures. The entire rotor assembly is dynamically balanced.



Accessible shaft-seals simplify maintenance and routine inspection. Shaft surface under packing glands is stainless steel. Covers are readily removable without disturbing the upper-half casing.



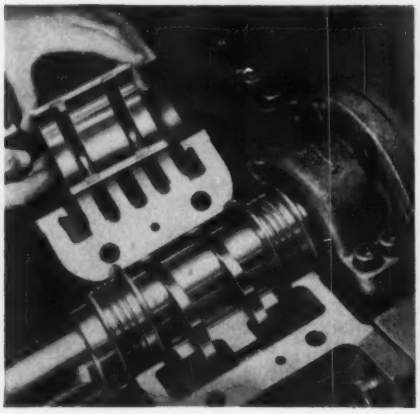
Simple, Positive direct-acting speed-governing system is dependable, weather-proof, accurate. Separate trip gives positive overspeed protection, and it may be easily reset against line pressure.

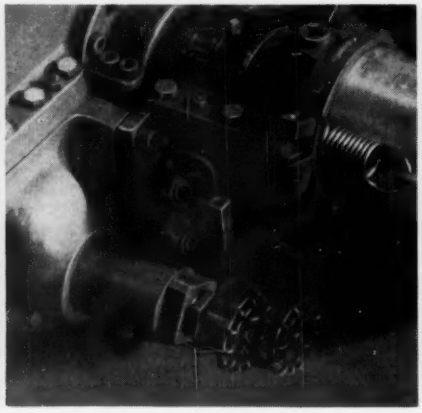
Only ELLIOTT Turbines give you all these PLUS features

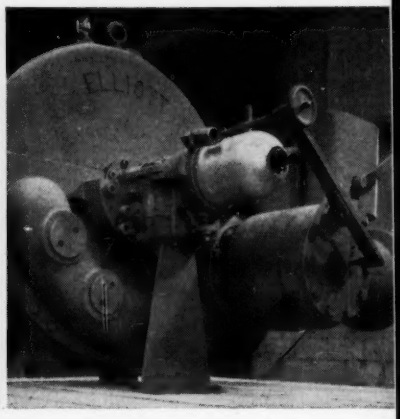
By separating the pedestal-mounted exhaust-end bearing from the hot turbine casing, the temperature distortion is minimized, and the vertical shaft movement is thereby eliminated.

Steam-saving hand valve with pilot, which can be opened against full steam pressure, reduces steam consumption at partial loads. This feature is available on all sizes of Elliott YR steam turbines.

All-weather protection is standard for Elliott YR turbines. They shrug off heat, dirt, snow, moisture or contaminated atmosphere. Stainless steel exposed parts are furnished for extreme conditions.

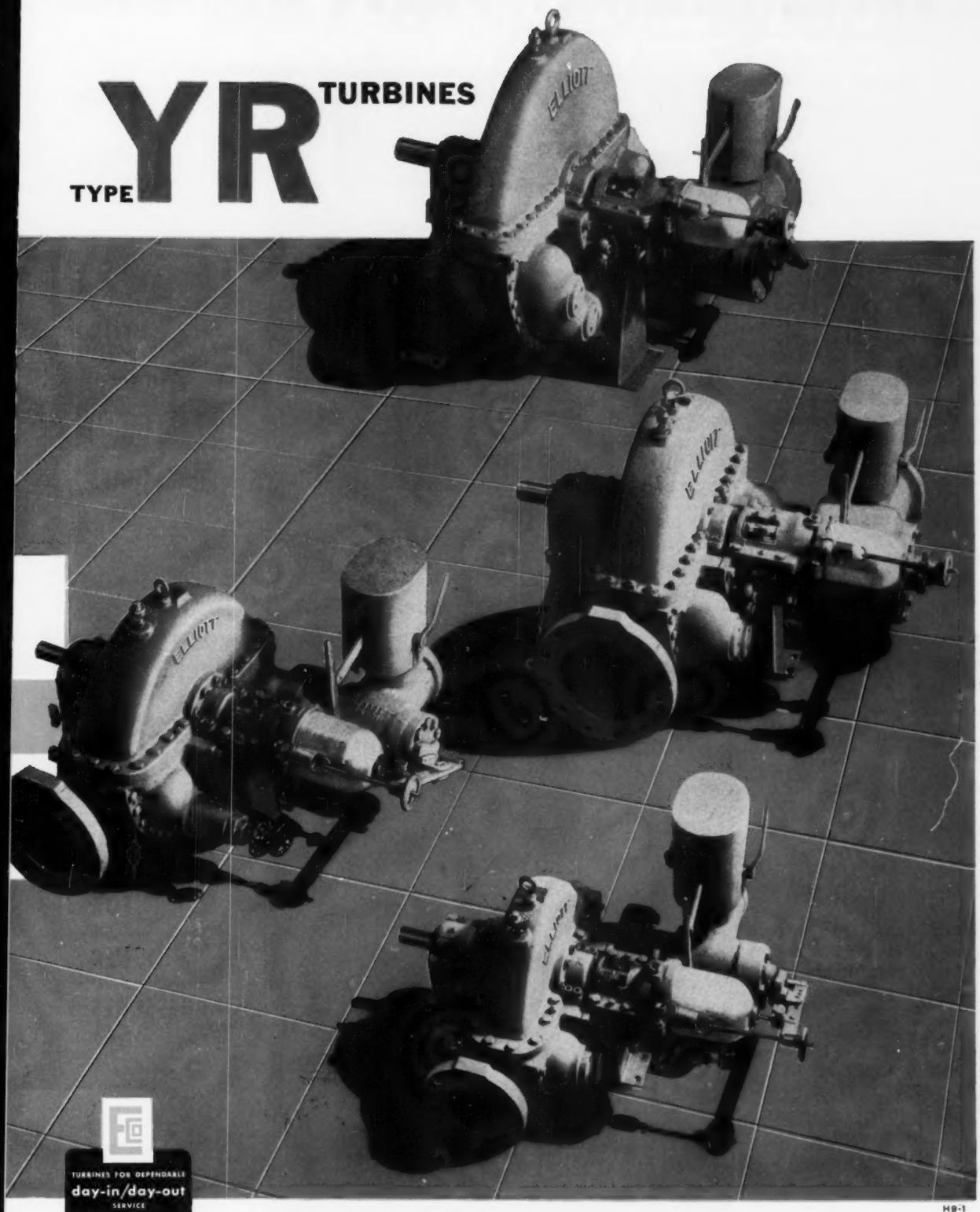






In addition to the units illustrated here, Elliott makes single-stage turbines in special frames, reduction gears, multistage mechanical drive turbines to 50,000 hp, and turbine-generators ranging through 44 mw.

TYPE YR TURBINES



TURBINES FOR DEPENDABLE
day-in/day-out
SERVICE

H9-1

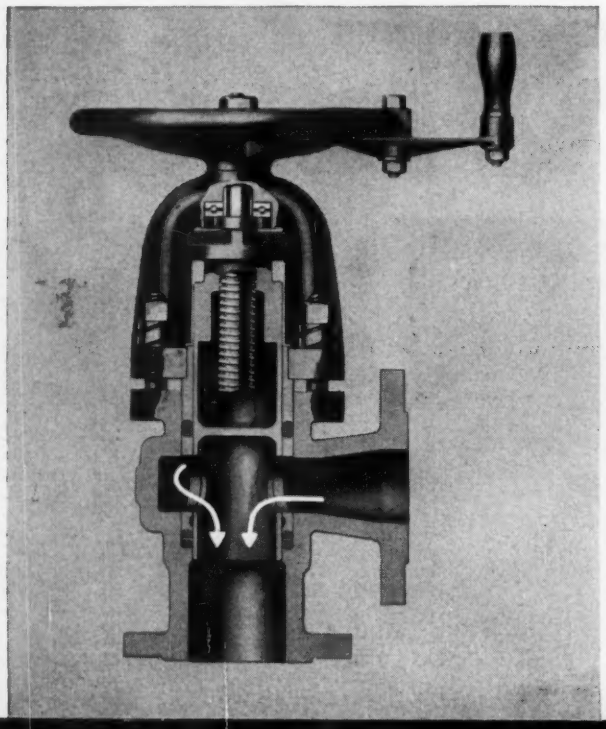
ELLIOTT Company JEANNETTE, PENNA.

For more facts circle 210 on Reader Service Card, p 102

These YARWAY VALVE DESIGNS

YARWAY SEATLESS

Features balanced nitralloy hollow plunger that seals line drop-tight, yet permits free, unobstructed flow in blow-down. Other features —laminated packing, alemite lubrication, ball thrust bearings. USED SUCCESSFULLY IN OVER 15,000 BOILER PLANTS.



FOR LOW and MEDIUM PRESSURES

YARWAY HARD-SEAT

Features tough, stellite-faced and ground disc and seat ring, mated to provide smooth long-wearing surfaces. Stream-line flow. Alemite lubrication. MORE THAN 4 OUT OF 5 HIGH PRESSURE BOILER PLANTS USE YARWAY BLOW-OFF VALVES.

FOR HIGHER PRESSURES

USED IN OVER 15,000 BOILER PLANTS

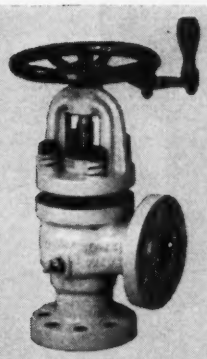
serve every boiler blow-down need

■ Whatever your *pressure* requirement, whatever your *piping* requirement—there's a Yarway Blow-Off Valve to exactly meet your needs.

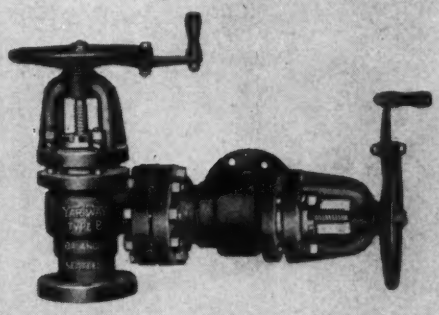
Popular Yarway *seatless* design keeps blow-down lines drop-tight in low and medium pressure ranges. Sturdy Yarway *stellite seat and disc* design protects higher pressures.

All Yarway Blow-Off Valves are strong, rugged valves, built to withstand the punishment of regular or emergency blowing-down under full boiler pressure, and are available in metals that stand up under acid washing of boilers.

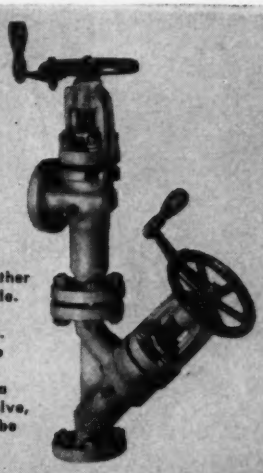
Write for new Yarway Blow-Off Valve Bulletins—B-426 (pressures to 400 psi) or B-434 (pressures to 2500 psi).



• Yarway Type B Seatless Blow-Off Valve, iron body for boiler pressures to 200 psi, steel bodies, for pressures to 400 psi. Angle valve shown, straightway available. Flanged connections. See Bulletin B-426.



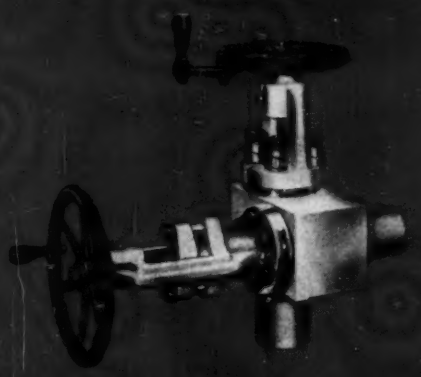
• Yarway Type B Seatless Tandem Blow-Off Valve combining two angle valves. Other combinations available. Iron bodies for boiler pressures to 200 psi, steel bodies for pressures to 400 psi. See Bulletin B-426.



• Yarway Type C Seatless Tandem Blow-Off Valve combining angle and straightway valves. Other combinations available. Flanged or welding connections available. For boiler pressures to 600 psi. NOTE: When used in tandem with a Yarway Hard-Seat Valve, Type C Seatless may be used to 1500 psi. See Bulletin B-434.

• Yarway Hard-Seat Blow-Off Valve for pressures to 2500 psi. Straightway valve shown. Angle available. Welded (shown) or flanged connections. See Bulletin B-434.

• Yarway Hard-Seat—Seatless Bolted Tandem Blow-Off Valve. Hard-Seat is the blowing valve, seatless is the cooling valve. Available in any combination of connections. For pressures to 1500 psi. Hard seat-hard seat tandems for pressures to 2500 psi. See Bulletin B-434.



• Yarway Hub Tandem Blow-Off Valve. Combines a hard-seat blowing valve and a seatless cooling valve in one-piece forged steel body for boiler pressures to 1500 psi. For pressures to 2500 psi, two hard-seat valves are combined. See Bulletin B-434.

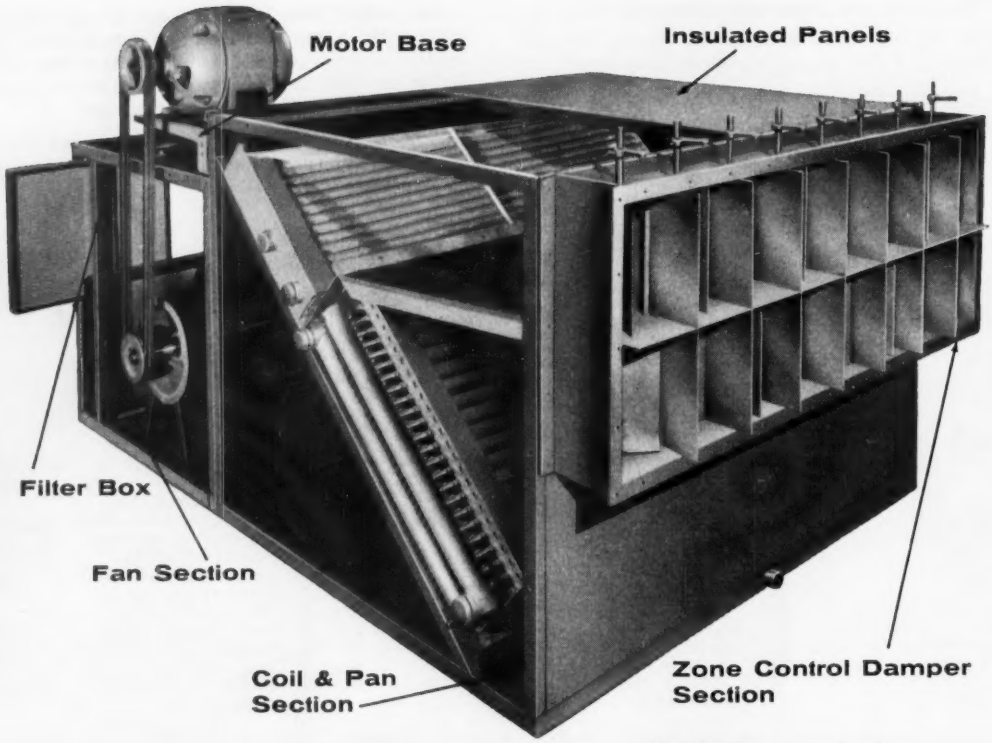
LET YARWAY HELP SOLVE YOUR BOILER BLOW-DOWN PROBLEMS!

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY

blow-off valves

For more facts circle 211 on Reader Service Card, p 102



"Buffalo" Zone Control Cabinet

IN AIR HANDLING EQUIPMENT, "BUFFALO" ADDS DEPENDABILITY TO EFFICIENCY

You can *depend* on "Buffalo" heating, cooling, ventilating units to provide a long, maintenance-free life of efficient, economical operation. That's because all "Buffalo" equipment is ruggedly built with heavy-duty construction throughout. Housings and panels are made of heavy-gauge steel, carefully welded for maximum strength. Extra-heavy construction is used where stress is greatest.

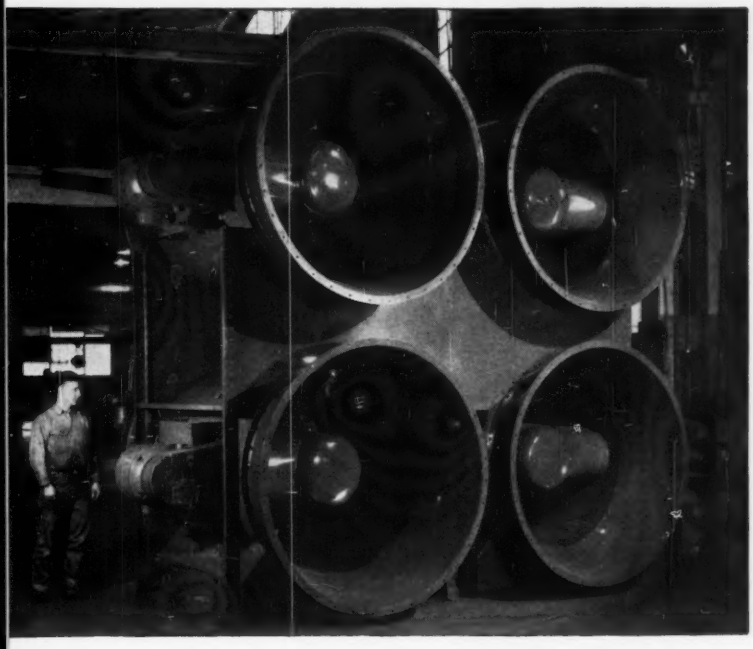
Oversized shafts and bearings are used for reserve strength under severe conditions. Shafts and fan wheels are factory balanced to insure minimum vibration. This further adds to higher efficiency and longer life. These are the reasons why many "Buffalo" fans and air conditioning units installed before the turn of the century are still "going strong".

For this same kind of dependable, economical, efficient air handling service, call in your nearby "Buffalo" engineering representative. Or write us direct for full information, including bulletins mentioned.

FOR INDIVIDUAL AREA COMFORT CONTROL. "Buffalo" Zone Control Cabinets, shown at left, are designed for installations where it is most economical to use a single unit to provide comfort conditioned air for several different areas. Temperature is controlled by mixing cooled and heated air from a single central source. Dampers regulate temperature to suit each conditioned space. Control for each area can be manual or automatic. Separate re-heat coils and their controls are eliminated.

These quiet, compact, efficient units are easy to assemble and install due to sectionalized construction. Heavy-gauge, corrosion-resistant components insure dependable, maintenance-free operation. Convenient access doors, removable panels and outside-located bearings simplify servicing.

"Buffalo" Zone Control Cabinets are available in many different combinations, for floor or ceiling installation. Extremely flexible, they can be adapted to any degree of heating, cooling and/or dehumidifying required. Write for Bulletin AC-220.

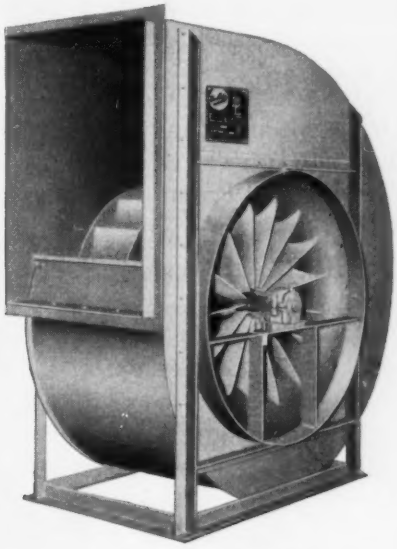


"Buffalo" Axials for Boiler Room Exhaust

FOR COMPACT INSTALLATION. Compact "Buffalo" Axial Flow Fans save space by hugging walls and ceilings. These rugged, reliable units serve as ventilation, exhaust and industrial air conditioning supply fans. Applications range from boiler room cooling to paint spray booth exhaust. Models are available for wide temperature ranges, corrosive fumes, explosive atmospheres.

Compact, lightweight "Buffalo" Axials are easily installed. No structural support or heavy foundation required, except for largest models. Quiet performance and high efficiency match economy of operation. Optional "Buffalo" Vane-axial outlet guide vanes convert swirling air at outlet into increased forward thrust. Write for Bulletin 3533-EF

FOR GENERAL AIR MOVING. The "Buffalo" Type "BL" Fan is a leading choice for large Class I and II ventilation, air conditioning and air cleaning systems. This fan is performance-proved for quiet, stable output from free delivery to shutoff. It is non-overloading through all pressure ranges. Minimum turbulence is the result of smoothly-curved inlet bell, directional guide vanes and matching shroud. Peak efficiency is assured by the streamlined wheel with backward-curved blades.



"Buffalo" Type "BL" Fan

Smooth air flow in the "BL" is further enhanced by the correctly shaped scroll of the wheel-contoured housing. Carefully built to Buffalo's rigid quality standards, the Type "BL" Fan is unsurpassed for reliability, economy and efficiency of operation. Write for Bulletin F-104.

Every "Buffalo" product brings you the famous "Q" Factor — the built-in QUALITY that provides trouble-free satisfaction and long life.

BUFFALO FORGE COMPANY

Buffalo, New York

Buffalo Pumps Division, Buffalo, New York
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

VENTILATING • AIR CLEANING • AIR TEMPERING • INDUCED DRAFT • EXHAUSTING
FORCED DRAFT • COOLING • HEATING • PRESSURE BLOWING

R/M POLY-V® DRIVE MEETS HEAVIEST LOAD REQUIREMENTS

Poly-V®
Drive Specifications
for 2500 Ton
Erie Forging Press:

Poly-V* Belt "M":
301″ P.L. x 9″ wide,
24 ribs.
Driver Sheave: 17″
P.D. 68″ Diameter
Flywheel.
100 Horsepower.

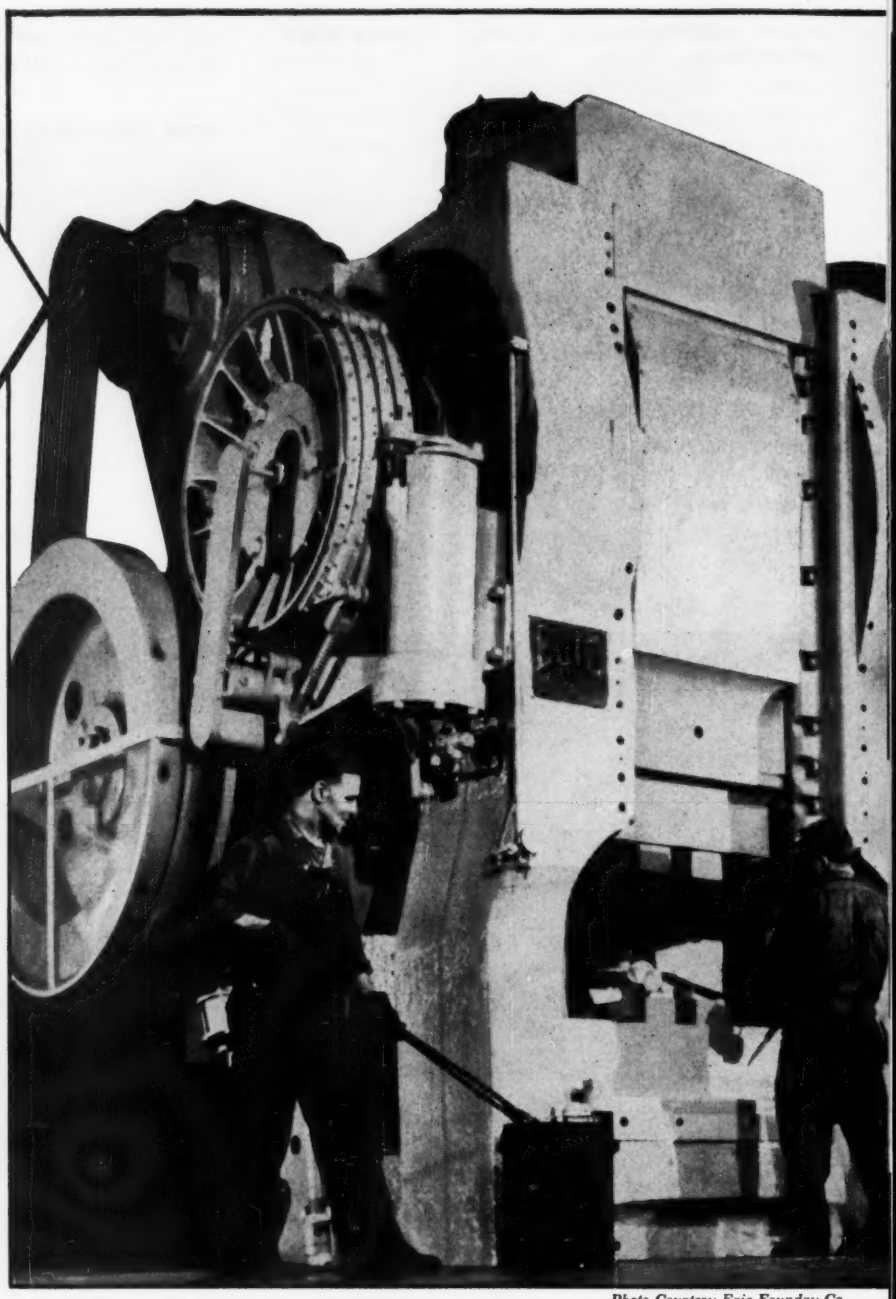
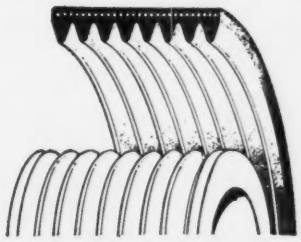


Photo Courtesy Erie Foundry Co.

R/M POLY-V* DRIVE...MORE USE PER DOLLAR

Compact Poly-V Drive delivers power to spare for this huge 2500 ton forging press, newly introduced to industry by Erie Foundry Company. R/M's patented drive design provides the higher horsepower capacity . . . more power per inch of drive width than ever before possible! Because it employs a single, endless V-ribbed belt running on sheaves specially designed to mate precisely with the belt ribs, Poly-V delivers up to 50% more power than ordinary V-drives of equal width . . . or equal power in as little as ⅔ the width. Poly-V Drives have narrower sheaves . . . less shaft overhang . . . less drive weight to meet *every* heavy duty application.

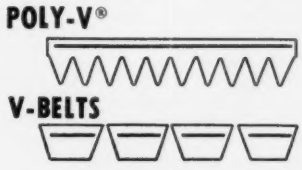
Poly-V's single unit belt design eliminates multiple-belt "length matching" problems, too. Belt speed ratio and belt position remain constant from no load to full load . . . assure smoother, cooler running—less wear on belts *and* sheaves! Just two belt cross sections meet every heavy duty drive requirement. Ask an R/M representative to help determine the R/M Poly-V* Drive specifications for your power driven equipment. Or write for Bulletin #M141.



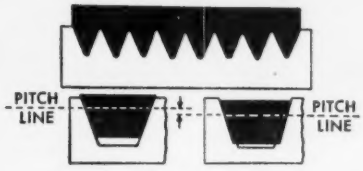
POLY-V GIVES GREATER POWER CAPACITY because it has *twice* the contact area with *half* the face pressure.

COMPARE: Measure the two bold lines to see the greater contact area of Poly-V* belt in the sheave.

AND POLY-V* has uninterrupted strength member of new high strength synthetic cord. Poly-V* is a single unit with even, uniform pull.

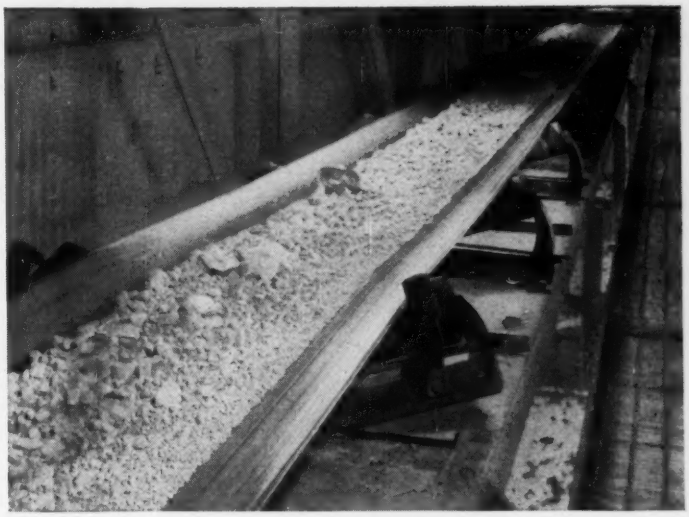


POLY-V* maintains constant pitch diameter under all loads. Speed ratio is unchanged. Belt position remains constant from *no* load to *full* load.



MORE POWER in SAME SPACE
or
EQUAL POWER in LESS SPACE

*Poly-V is a registered Raybestos-Manhattan trademark.



R/M CONVEYOR BELTS FOR LONGER SERVICE

Extra flexible Ray-Man trains naturally, troughs easily... handles fuller, *heavier* loads even where narrow belts and small pulleys are required. Holds fasteners under severe conditions of use, requires no breaker strip. For severe shock loading, R/M makes extra-cushioned Homocord... and R/M Tension-Master for extra long lifts, high tensions. Exclusive "XDC" Cover protects R/M heavy duty belts against wear, tear, cuts and abrasions. Write for Bulletin #M302.

ALLFLEX HOSE IS STRONG *AND* FLEXIBLE

Exclusive engineered advantages of Allflex hose add up to easier handling, longer life... lower hose costs for a variety of uses. This versatile, all-purpose construction has no pre-set twist... coils and uncoils freely in *any* direction. Uniform inside and outside diameters assure safer, easier coupling. One of a complete line of quality R/M hose constructions for general and special purpose use... engineered for "More Use per Dollar" on every job! Write for Bulletin #7075.

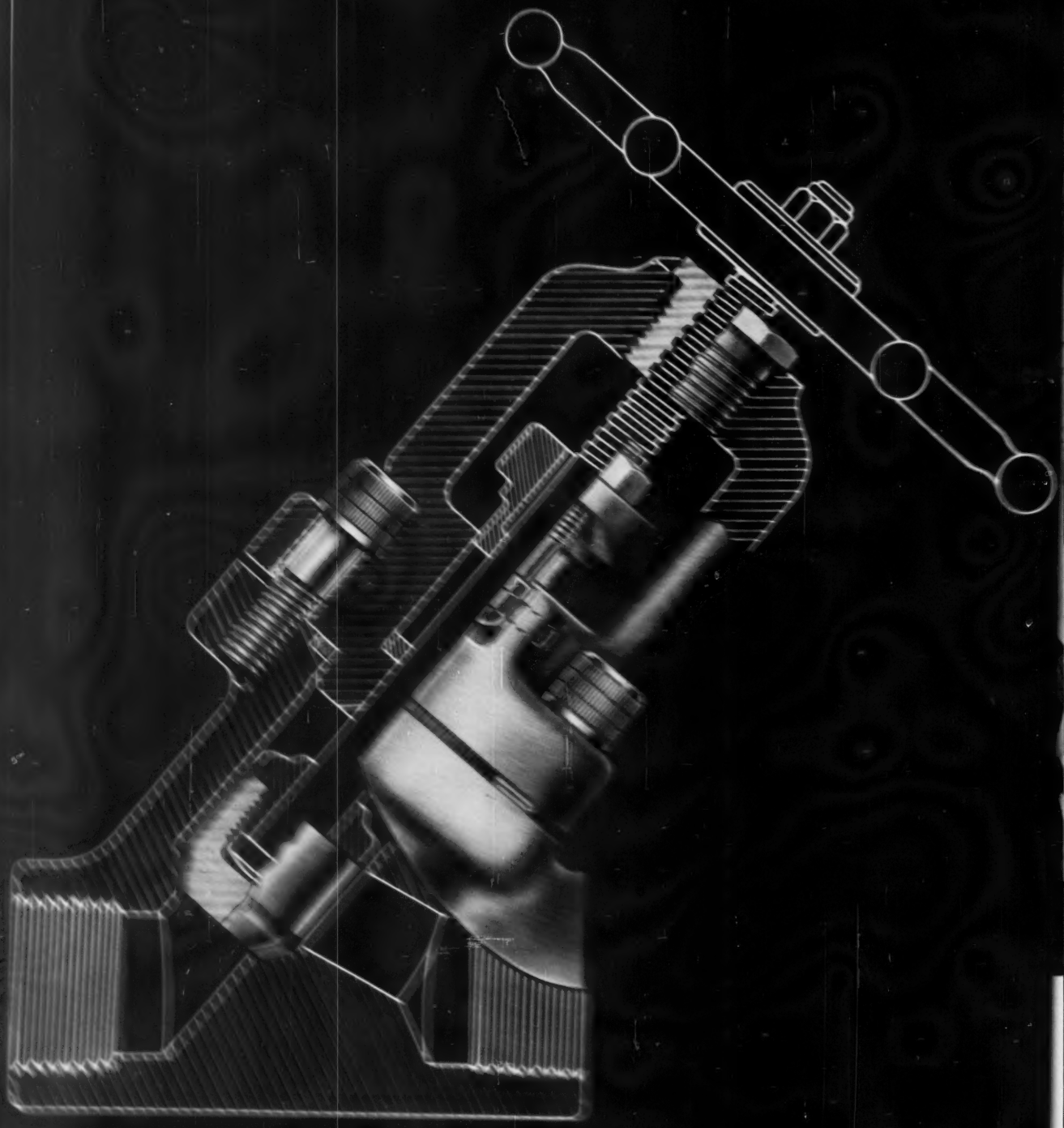
RM 917

BELTS • HOSE • ROLL COVERINGS • TANK LININGS • INDUSTRIAL RUBBER SPECIALTIES

MANHATTAN RUBBER DIVISION—PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.

Other R/M products: Abrasive and Diamond Wheels • Brake Blocks and Linings • Clutch Facings • Asbestos Textiles • Mechanical Packings • Engineered Plastics • Sintered Metal Products • Industrial Adhesives • Laundry Pads and Covers • Bowling Balls



EDWARD "848" SERIES GLOBE VALVE

(ANGLE TYPE ALSO AVAILABLE)

What's New from Edward Valves

New Products . . . Problems and Solutions. . . Information on Steel Valves from Edward, Long-Time Leader in the Field!

Major Improvements at No Extra Cost Mark New "848" Series Forged Steel Stop Valves

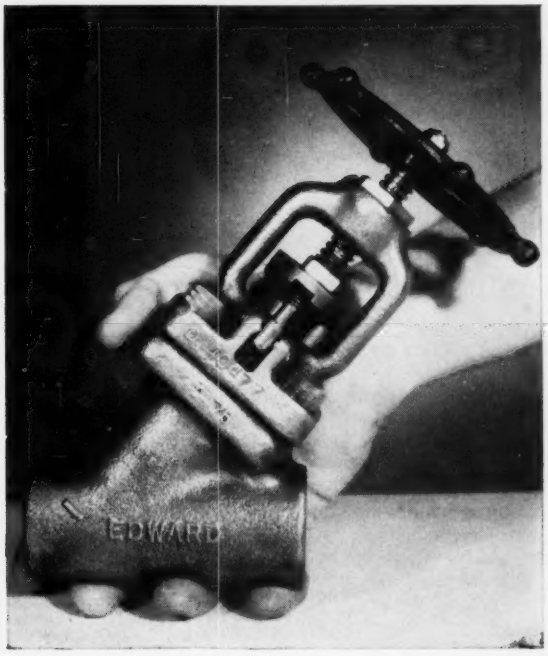
In an industry where any change in design is "news," Edward is proud to introduce a new line of 600-lb forged steel stop valves with so many major design improvements *at no increase in cost.* These Rockwell-built Edward valves are suitable for air, water, oil and other hydrocarbons, anhydrous ammonia and other gases, steam and other non-corrosive fluids.

NEW MATERIALS USED THROUGHOUT

Besides tough drop-forged steel, which is the basis of these valves, Edward introduces such innovations as stainless steel gland bolts, an aluminum-bronze yoke bushing, solid disk of chromium-cobalt-tungsten stainless steel, spiral wound gasket of stainless steel and asbestos, and special alloy cap screws linking body and bonnet.

NEW IMPROVED BODY-BONNET JOINT

Four molybdenum alloy cap screws secure bonnet to valve body. These compact, high-strength cap screws require less space than ordinary nuts and bolts, can be handled with one hand, and deliver maximum compressive force with minimum tightening torque. A new spiral wound gasket, consisting of some 20 turns of stainless steel and asbestos, provides controlled compression not possible with ordinary flat gaskets. Because this spiral wound gasket is free to expand and contract as needed, it "takes up the slack," maintains a leak-proof seal between body and bonnet.



NEW SOLID DISK OF SPECIAL ALLOY

Disk is made of chromium-cobalt-tungsten stainless steel. This new alloy has added resistance to erosion, holds its hardness better under high temperatures than other disk materials. Disk is lock-welded to disk-nut, eliminating wobble and chatter—especially important when valve is called upon for throttling duty.

INTEGRAL STELLITE SEAT FOR LONG LIFE

Valve seat is Stellite—a harder, longer-wearing material with excellent resistance to corrosion, erosion and temperature. Seat is integrally welded to body.

"848" SERIES ROCKWELL-BUILT EDWARD VALVES are available in ¼", ⅜", ½", ¾" and 1" sizes. They are rated at 600 psi—at 910F in carbon steel and at 1030F in chrome-molybdenum steel. Globe or angle types, with screwed or welding ends. Write for facts on performance . . . price . . . and delivery. Address *Edward Valves, Inc., 1230 West 145th Street, East Chicago, Indiana.* (Subsidiary of Rockwell Manufacturing Company.) Represented in Canada by Lytle Engineering Specialties, Ltd., 360 Notre Dame St. W., Montreal 1, Quebec.

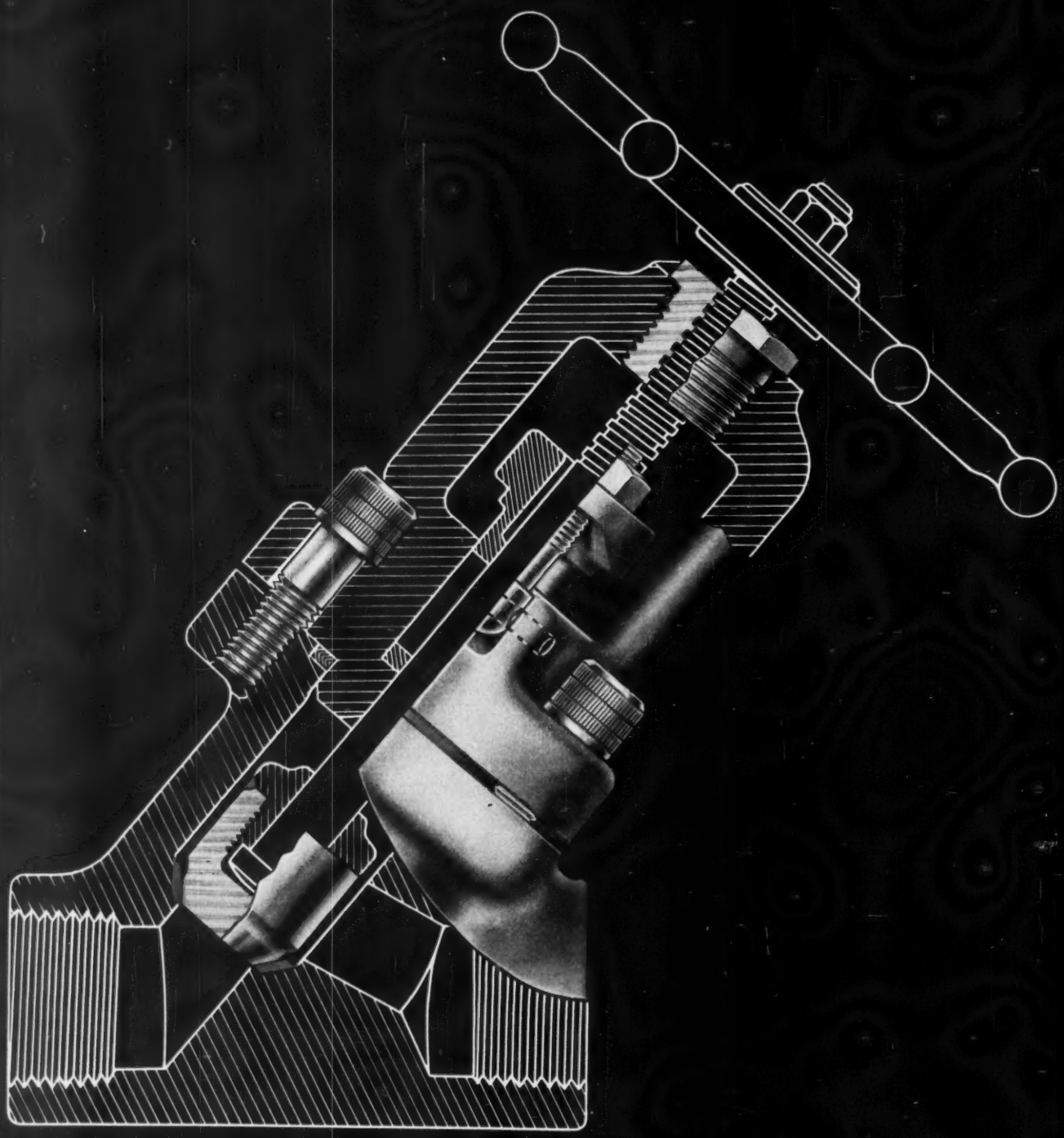
EDWARD STEEL VALVES

another fine product by

ROCKWELL

Catalog 14 contains full data on the complete Edward line of forged and cast steel valves from ¼" to 18"; in globe and angle stop, gate, non-return, check, blow-off, stop-check, relief, hydraulic, instrument, gage and special designs; for pressure up to 10,000 lbs; with pressure-seal, bolted, union or welded bonnets, with screwed, welding or flanged ends.

For more facts circle 214 on Reader Service Card, p 102



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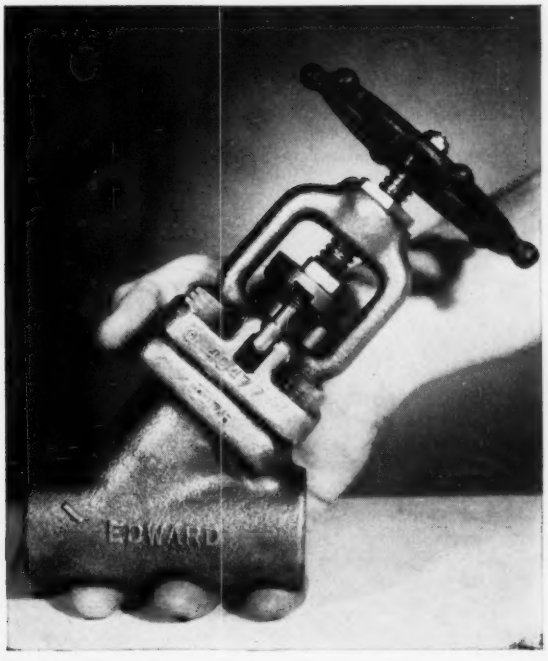

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For more facts circle 214 on Reader Service Card, p 102

The Right Refractory For Each Specific Need

IMPROVES BOILER

Harbison-Walker provides the most comprehensive line of Boiler Furnace Refractories

REFRACTORIES FOR MONOLITHIC CONSTRUCTIONS

Harbison-Walker Plastic Fire Brick, Castables and Ramming Mixes, comprise all the classes which are best adapted for the many different kinds of service and furnace design.

H-W Castable Refractories

These refractory concrete products all having a strong hydraulic set serve admirably for many boiler furnace and accessory uses as in pouring baffles, arches, walls, door linings, ash hoppers and sluicing troughs. Included in the eighteen different brands is H-W EXTRA STRENGTH CASTABLE which is exceedingly strong and wear resistant, yet has high spalling resistance and is suitable for use at temperatures up to 2400°F. H-W HIGH ALUMINA CASTABLE fulfills the requirements for highest operating temperatures. In the paper mill industry, H-W CHROME CASTABLE has become regarded as standard for linings of recovery boilers. The several H-W Lightweight Castables combine the desirable properties of light weight, heat insulation and adequate refractoriness for their applications.

H-W Plastic Fire Brick

Harbison-Walker Plastic Refractories comprise all brands best adapted for the many different operating conditions. They form solid, joint-free linings, and are used for the construction of arches, target, baffle and bridge walls, burner ports and irregular shapes. They have physical properties closely similar to corresponding classes of refractory brick.

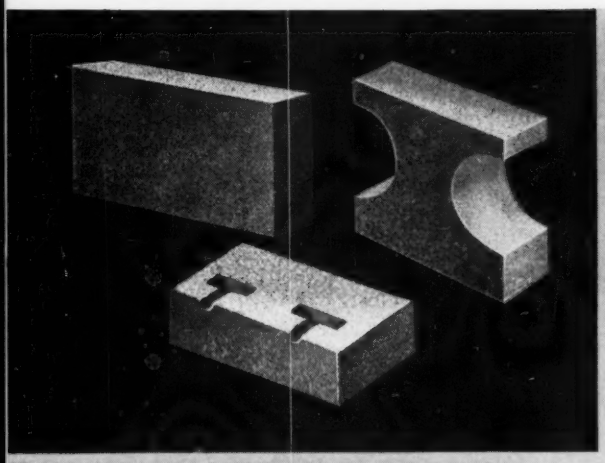
H-W STANDARD PLASTIC FIRE BRICK is a dense-burning, uniform refractory made of the same clean, high-purity flint clay of hard burn and plastic bond clay as are used in the best high duty fireclay brick.

H-W SUPER PLASTIC FIRE BRICK possesses the properties of super-duty fireclay refractories and is used economically in applications where temperatures exceed the limits for H-W STANDARD PLASTIC FIRE BRICK.

H-W SUPER PLASTIC-CS takes a cold-set after drying in the low temperature range. This added strength prior to the development of the usual strong ceramic set is especially desirable for certain furnace installations.

To meet all the widely different conditions in the operation of steam power generating plants, Harbison-Walker produces the complete range of refractories from which can be selected the particular kinds for the best balance in service and economy. These refractories are manufactured in many states—and warehouse stocks are available in many cities and towns throughout North American and various other countries. Transportation time and cost benefits are obvious.

PERFORMANCE



APACHE Plastic Fire Brick is the high alumina plastic refractory which withstands the highest temperatures to best advantage and is most resistant to chemical attack by corrosive slags.

H-W Ramming Materials

THERMOLITH BATCH furnished both dry and ready mixed has a chrome ore base and because of the chemical composition and dense impervious texture developed when heated, it renders outstanding service in bottoms of slag tap boilers.

KORUNDAL RAMMING MIX (shipped dry) is a high alumina base material especially suited for use at extremely high temperatures.

HARBISON-WALKER REFRACTORY BRICK AND SHAPES WITH CORRESPONDING MORTARS

The many different brands of fireclay brick of all classes, high alumina brick ranging up to 99% alumina and H-W SILICON CARBIDE, along with corresponding mortars afford the best choice for substantially every combination of conditions. The H-W high alumina brands provide maximum resistance to exceedingly corrosive oil ash high in vanadium oxide and alkalies, ash of organic refuse including wood waste and sugar mill bagasse and certain coal clinker compositions. The H-W SILICON CARBIDE which is highly resistant to oxidation is best for withstanding the corrosive action of many fusible coal ash deposits.

H-W INSULATING REFRACTORIES

Harbison-Walker Insulating Fire Brick are made in eight different brands, each of which is suitable for use to best advantage for various sets of operating conditions. Other H-W insulating refractories are H-W BLOCK INSULATION and H-W MINERAL FIBER COATING. Included also are insulating castables ranging in weight from 30 to 85 pounds per cubic foot (weight of dense castables 115 to 180 p.c.f.) with service temperature limits from 1000°F. to 3000°F.

Technical Service based on the most extensive experience and research is freely offered to help you select the refractories best suited for your specific requirements.

HARBISON-WALKER REFRACTORIES COMPANY AND SUBSIDIARIES

World's Most Complete Refractories Service

***GENERAL OFFICES:* PITTSBURGH 22, PENNSYLVANIA**

For more facts circle 215 on Reader Service Card, p 102

View at burner and mill-feeder level of one of the four C-E Boilers which serves the Milwaukee plant.

"The Beer That Made Milwaukee Famous"...

Eleven C-E boiler units, ranging from the semi-outdoor, oil-fired package type to the pulverized coal-fired, vertical unit type, provide the steam to make "The Beer That Made Milwaukee Famous."

Since 1946, when the Jos. Schlitz Brewing Company purchased four C-E boilers as part of an expansion and modernization program at Milwaukee, the Company has purchased C-E units for its breweries in Brooklyn, N. Y., Los Angeles, Calif., and Tampa, Fla.

Due to the nature of brewing and bottling operations, load swings are wide and rapid, and boiler response must be both unfailing and prompt. How well C-E boilers have met this challenge is evidenced by the repeat order record—a record made even more impressive by the fact that the Jos. Schlitz Brewing Company has obtained consistently high performance with not just one type of C-E boiler—but with three.

When you need a reliable and efficient source of steam — remember that the Schlitz slogan "Move Up to Quality" applies to boilers as well as beer.

Two oil-fired C-E boilers, Type VU-10, supply 60,000 lb. of steam per hr. for process purposes at the Schlitz brewery in Brooklyn, N. Y.

COMBUSTION

Combustion Engineering Building,

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS;

The Schlitz "headquarters" brewery at Milwaukee uses 4 pulverized coal-fired C-E boilers, Type VU, each with a capacity of 60,000 lb. per hr.

is brewed with C-E STEAM

This 20-million dollar showplace is the Schlitz brewery in Los Angeles, California, which uses 3 C-E boilers, Type VU-10. Fired with natural gas and oil, they generate 90,000 lb. of steam per hr.

At its Tampa, Florida, brewery, Schlitz uses 2 semi-outdoor C-E Package boilers, Type VP. They provide 72,000 lb. of steam per hr.

ENGINEERING

C-E

C-196

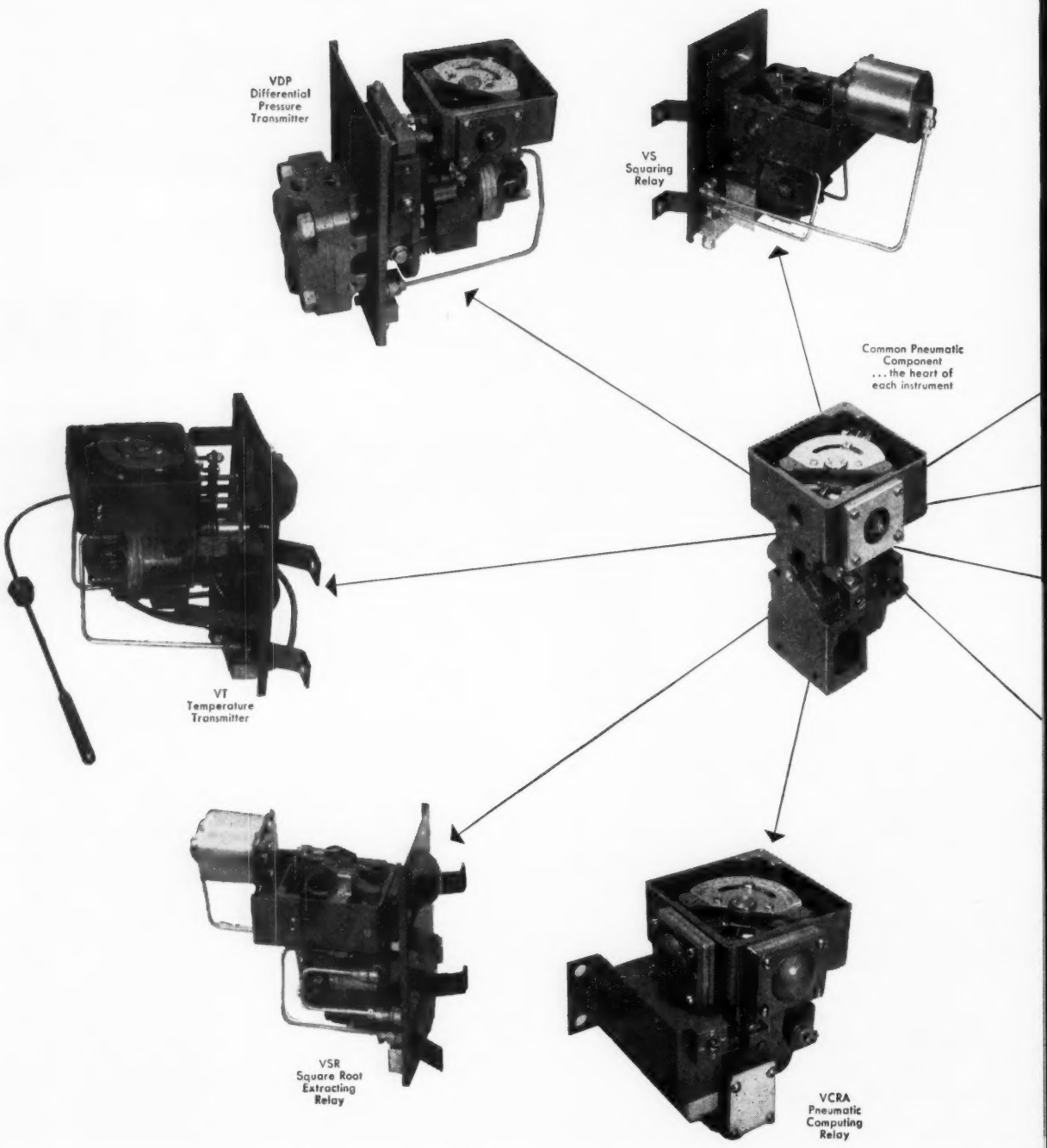
200 Madison Avenue, New York 16, N. Y.

PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

For more facts circle 216 on Reader Service Card, p 102

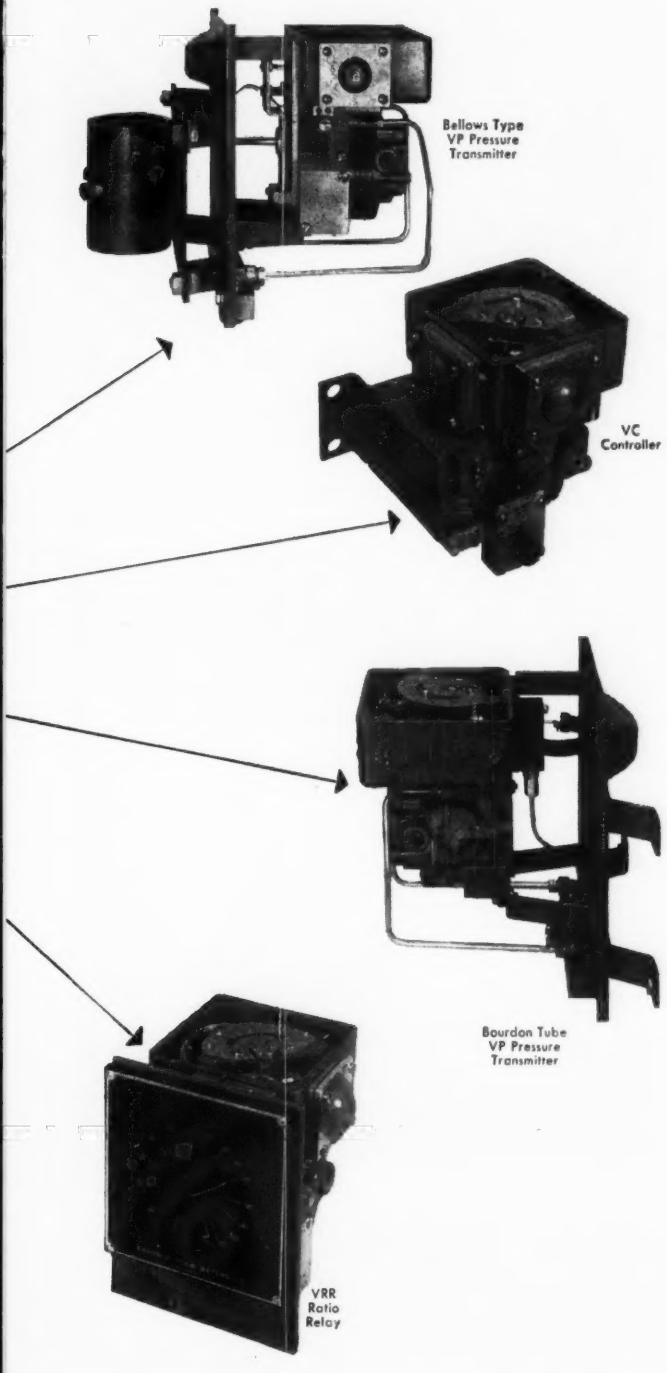
Rockwell-Built REPUBLIC

serve any process,



VECTOR SERIES INSTRUMENTS

cut costs too!



You can save substantial money when your control systems are based on Republic's Null-Balance Vector instruments. Each has as its "heart" an identical pneumatic component, with obvious advantages. Among these are interchange of parts, even among instruments performing entirely different functions. Besides involving a minimum spare parts inventory, this feature greatly simplifies personnel training.

Components shown demonstrate the depth of the Republic line. Differential pressure transmitters with 20-to-1 range adjustment . . . temperature transmitters with 10-to-1 range adjustment . . . pressure transmitters of ±0.5% accuracy. We have ratio, totalizing, multiplying, squaring and square root extracting relays. Our all-purpose controllers feature proportional band adjustment of 2% to 500% and reset adjustment from 0.1 to 50 repeats per minute.

The Republic Engineer in your area will be glad to work with you on any control or measurement problem. Sales offices in principal cities throughout the United States and Canada. Call or write—with no obligation, of course—*Republic Flow Meters Company*, 2240 Diversey Parkway, Chicago 47, Illinois (subsidiary of Rockwell Manufacturing Company). In Canada: Republic Flow Meters Canada, Ltd., Toronto.

REPUBLIC INSTRUMENTS AND CONTROLS
more fine products by
ROCKWELL

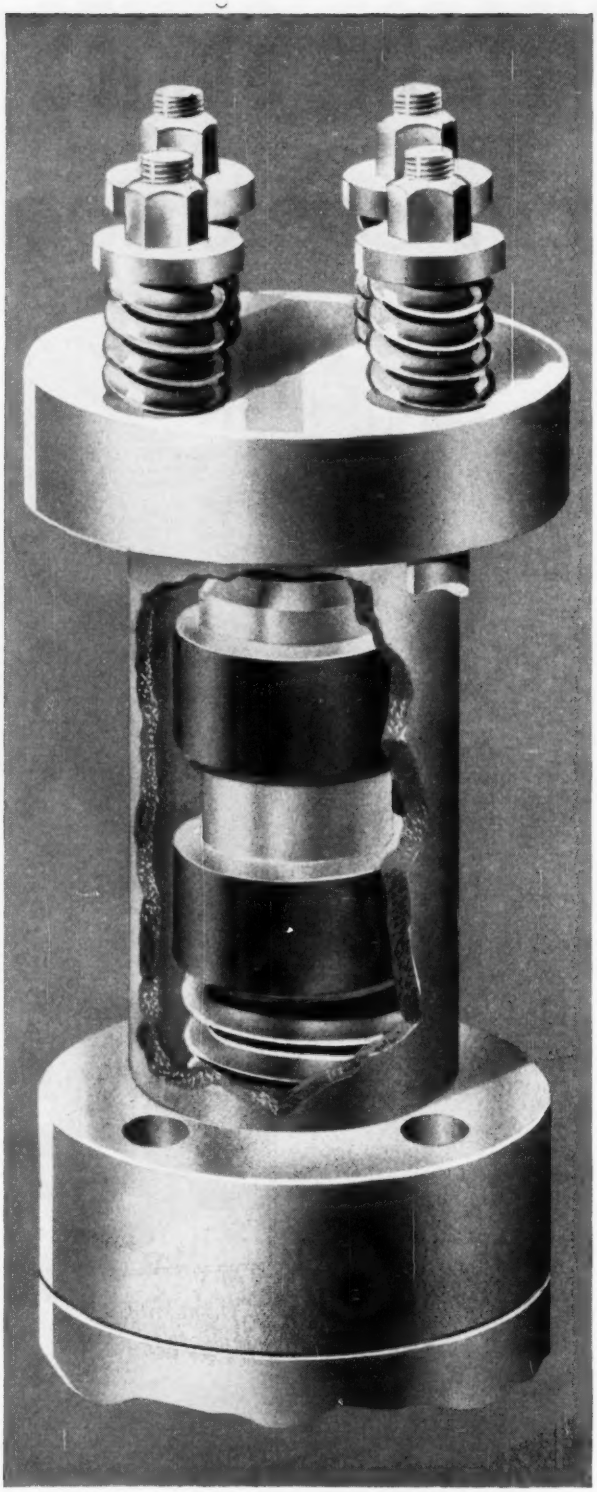
For more facts circle 217 on Reader Service Card, p 102

NOW KOPPERS LEADS AGAIN

by bringing you lower precipitator maintenance and operating costs with

K-30*

bonded pistons on pneumatic vibrators



By eliminating the need for lubrication of the rapping mechanism in electrostatic precipitators, Koppers saves you many operational man-hours and maintenance costs.

This lubrication-free operation results from bonding a new wear-resistant material to vibrator piston surfaces. This special self-lubricating compound, identified by Koppers as "K-30," is composed of Teflon† and other wear-resistant materials that together provide a self-lubricated surface.

Most rapping mechanisms demand regular maintenance to be trouble-free, but "K-30" eliminates this need and provides more reliable operation.

Koppers research, backed by many years of experience in the electrostatic precipitation field will help you find the answer to your gas cleaning problems. Check with Koppers to learn how "K-30" can develop top efficiency in present or planned precipitator installations. For more information, write: KOPPERS COMPANY, INC., 6502 Scott Street, Baltimore 3, Maryland.

*Koppers Trademark

†E. I. duPont de Nemours & Company, Inc. trademark for tetrafluoroethylene resin

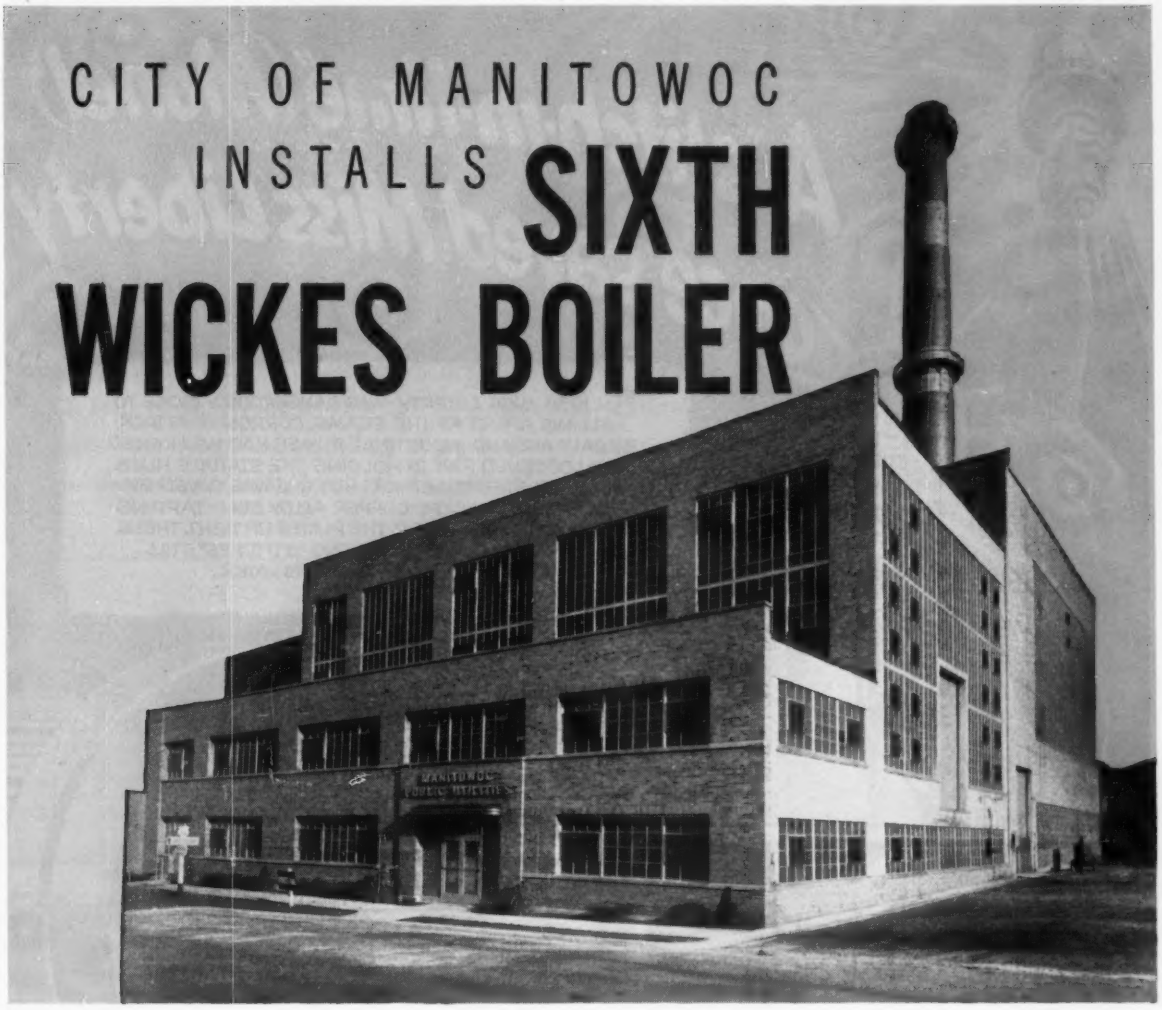
KOPPERS

ELECTROSTATIC PRECIPITATORS

Engineered Products Sold with *Service*

For more facts circle 218 on Reader Service Card, p 102

CITY OF MANITOWOC INSTALLS SIXTH WICKES BOILER



R. E. Cannard—Chief Engineer and General Manager

Manitowoc Public Utilities Commission has just installed the sixth Wickes Steam Generator to help provide power for the City of Manitowoc, Wisconsin, and its surrounding area. The continued selection of Wickes equipment by this progressive municipality is a tribute to the dependability and quality of Wickes Steam Generators.

Wickes Boiler Co. builds steam generators for all branches of industry . . . for municipalities and for private and public buildings. Wickes units are available in sizes up to 500,000 lbs. of steam per hour and are designed for high or low steam pressures and temperatures, and for all types of fuels and firing methods. There is a Wickes design available for your needs.

Write for bulletin 55-1, showing the wide variety of designs and sizes available in both field-erected and shop-assembled* steam generators, or ask the nearest Wickes representative to call on you for full information.

*For the latest developments in shop-assembled boilers, investigate Wickes natural circulation A-type water tube units now built for capacities up to 75,000 lbs. per hour for oil and gas fuels. Request bulletins 56-1 and 57-1 for full information.

170

WICKES

WICKES BOILER CO., SAGINAW 10, MICHIGAN
DIVISION OF THE WICKES CORPORATION
RECOGNIZED QUALITY SINCE 1854 • SALES OFFICES: Boston • Chicago Cleveland • Dallas • Denver • Detroit • Houston • Indianapolis • Los Angeles Memphis • Milwaukee • New York City • New Orleans • Portland, Ore. Saginaw • San Francisco • Springfield, Ill. • Tulsa

For more facts circle 219 on Reader Service Card, p 102

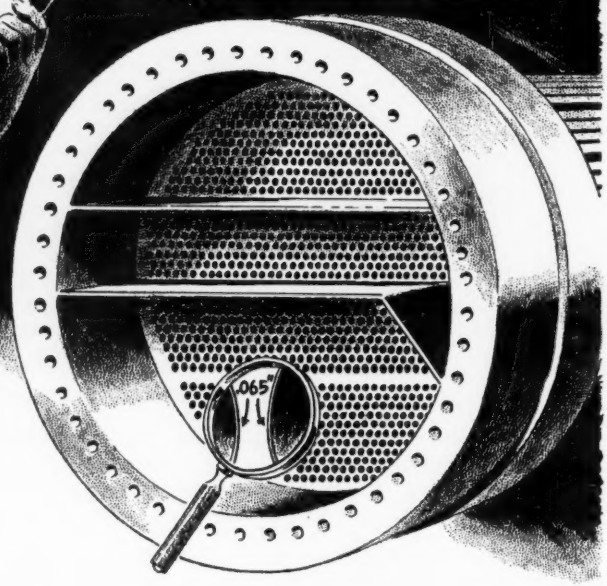
A "stitch-in-time" (Monel) once saved Miss Liberty

IN 1938 MISS LIBERTY WAS DANGEROUSLY CLOSE TO FALLING APART AT THE SEAMS. CORROSIVE ATTACK BY SALT AIR AND INDUSTRIAL FUMES HAD WEAKENED AND LOOSENED RIVETS HOLDING THE STATUE'S HUGE METAL PLATES TOGETHER. BUT SHE WAS SAVED BY 65,000 MONEL* NICKEL-COPPER ALLOY SELF-TAPPING SCREWS WHICH PULLED THE PLATES UP TIGHT. THESE STRONG, CORROSION-RESISTING "STITCHES" STILL LOOK GOOD TODAY—20 YEARS LATER.

Inconel "X" Spring starves "hungry" water...

Withstands corrosive bite of 13,000 tons per hour, at 600°F

13,000 TONS PER HOUR OF HIGH-PURITY WATER AT 500-600°F FLOW THROUGH THE CORE MOUNT SPRINGS OF A NUCLEAR POWER REACTOR. TO PREVENT STRESS-CORROSION CRACKING OR EMBRITTLEMENT, THE DESIGNERS CALLED FOR INCONEL* "X"* AGE-HARDENABLE NICKEL-CHROMIUM ALLOY. SPRINGS MADE OF THIS ALLOY RESIST CORROSION AND RELAXATION AT HIGH TEMPERATURES—UP TO 1100°F IN SOME CASES!



Thin-wall 4300 psi heater tubes—5/8" O.D.

THESE ARE THE FACTS ON THE MONEL ALLOY U-TUBES IN FINAL STAGE FEEDWATER HEATERS, NOW AT A NEW OHIO POWER STATION. THEIR 85-FOOT LENGTH MAKES THEM THE LONGEST MONEL ALLOY TUBES EVER MADE. ALTHOUGH THESE TUBES ARE DESIGNED TO WITHSTAND A WATER PRESSURE OF 4300 PSI, THEY'RE ATTACHED TO THE TUBE SHEETS BY ROLLING ONLY! QUITE A TRIBUTE TO STRENGTH AND DUCTILITY OF MONEL ALLOY.

Need help on a metal problem?

THERE'S A GOOD CHANCE THAT INCO'S MECHANICAL ENGINEERING SECTION HAS ALREADY SOLVED A PROBLEM SIMILAR TO YOURS. WHY NOT CONTACT THEM RIGHT AWAY FOR ASSISTANCE? JUST LET US KNOW THE DETAILS.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N. Y.

INCO

*Registered trademark

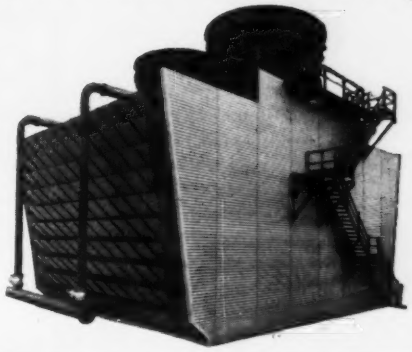
INCO NICKEL ALLOYS

For more facts circle 220 on Reader Service Card, p 102

1958 TOWER TESTS

Marley's 3rd Annual Report to Industry

The day of "hazard buying" of cooling towers is past. To substantiate this, Marley encourages purchasers to TEST YOUR TOWER and each year publishes the results of these tests. This list of tests is not selected or edited—it is a consecutive record of ALL tests of Marley Cross-Flow towers during 1958. Seventeen tests were conducted according to accepted test code procedure—*more than reported by all other manufacturers combined.*



TEST NO.	TYPE OF SERVICE AND LOCATION	SPECIFIED CONDITIONS				TEST RESULTS	
		Gallons Per Minute	Hot Water Temp.	Cold Water Temp.	Wet Bulb Temp.	Degrees Cold Water Temp.	Percent Capacity
1*	Petroleum Refinery—North Central	5,200	120°	84°	74°	+0.44°	+3.5%
2*	Chemical Process—Mountain States	7,000	90°	75°	65°	+0.65°	+7.2%
3*	Power Plant—West Coast	31,500	109.4°	91°	80°	+0.35°	+2.6%
4†	Petroleum Refinery—Gulf Coast	28,000	113°	93°	82.5°	+0.37°	+2.9%
5†	Petroleum Refinery—Gulf Coast	16,000	112°	91.5°	82.5°	+1.50°	+9.6%
6*	Power Plant—Mid-Central	14,750	102°	87°	75°	+0.40°	+3.1%
7	Petroleum Refinery—Gulf Coast	25,000	120°	95°	82.5°	−0.30°	−2.0%
8†	Power Plant—Mid-Central	7,000	96°	85°	75°	−0.05°	−0.5%
9*	Petroleum Refinery—North-Central	9,300	110°	84°	74°	+0.40°	+3.0%
10	Power Plant—Mid-Central	9,500	100°	86°	75°	+0.10°	+0.8%
11†	Power Plant—Mid-Central	16,000	102.2°	90°	75°	+0.30°	+2.0%
12†	Petroleum Refinery—Mid-Central	23,250	106.5°	88.5°	77°	+1.60°	+12.6%
13	Power Plant—Mid-Central	60,000	99°	84°	74°	+0.30°	+3.1%
14†	Petroleum Refinery—Gulf Coast	45,000	112°	89°	82.5°	−0.54°	−5.2%
15	Petroleum Refinery—Gulf Coast	6,000	115°	85°	79°	+0.30°	+3.6%
16	Air Conditioning—Mid-Central	4,200	96°	85°	78°	+0.30°	+3.5%
17*	Power Plant—Mid-Central	44,000	99.5°	86°	74°	+0.80°	+7.2%
18†	Power Plant—Southwest	61,500	106.5°	88.5°	76.5°	+1.20°	+11.0%
19*	Petroleum Refinery—East-Central	8,000	115°	85°	75°	+0.50°	+4.0%
20†	Petroleum Refinery—Gulf Coast	57,500	120°	85°	79°	−0.03°	−0.03%
21	Petroleum Refinery—Gulf Coast	18,830	112°	85°	79°	+0.14°	+1.5%
22†	Petroleum Refinery—Gulf Coast	34,000	113.5°	87.5°	80°	+0.12°	+1.2%

*Code Test (observer not present) †Code Test (observer present)

Here is positive proof of "in service" performance—the strongest possible assurance that Marley towers are bid and built to equal or exceed specified performance. If you believe with Marley that every industrial tower owner is entitled—if not obligated—to know the capability of his tower, before and after installation, write today for these Marley technical bulletins: "Analyze Your Bids" and "Test Your Tower."

MARLEY

The Marley Company

Kansas City, Missouri

For more facts circle 221 on Reader Service Card, p 102

Johnson Controls Provide Ideal Working Climate in This Award-Winning Plant

Listerine, Richard Hudnut, Du Barry and other famous name products are made here. Johnson Controls keep this air conditioned packaging area as comfortable as an executive office.

One of the outstanding assets of the efficient new Lambert-Hudnut plant in Lititz, Pennsylvania, is its physical environment. Its striking design, scenic setting, spacious, bright plant and office areas and excellent employee facilities rate with the best anywhere! *Factory* magazine named it one of the top 10 plants in 1957.

A key feature of this modern environment is a specially planned Johnson Pneumatic Temperature Control System that operates the plant's high velocity, dual duct air conditioning systems, the high temperature (350 F) hot water heating system and the ventilating systems. Flexibly engineered so that each room or work area is individually controlled, the Johnson System assures an ideal working climate for Lambert-Hudnut employees.

Lambert-Hudnut Manufacturing Laboratories, Lititz, Pa., subsidiary of Warner-Lambert Pharmaceutical Co. A. M. Kinney, Inc., architect and engineer, Cincinnati; R. E. Lamb, general contractor, Philadelphia; Howard P. Foley Co., mechanical contractor, Pittsburgh.

Such an environment makes important contributions to working efficiency, helps attract and hold good employees and cut absenteeism and costly turnover. (In many plants, too, products must be handled and processed under closely controlled temperature and humidity conditions.)

When *you* build or air condition, ask your consulting engineer, architect or local Johnson representative to show you how Johnson Pneumatic Controls can provide you with similar benefits. The specialist Johnson organization has installed the pneumatic temperature control systems in a majority of the nation's leading buildings, of all types and sizes. Johnson Service Company, Milwaukee 1, Wisconsin. 105 Direct Branch Offices.

GET THE "PLUS" VALUES OF PNEUMATIC CONTROLS BY JOHNSON

- **Widest Application.** Johnson Controls are applied to all types and makes of air conditioning, heating and ventilating equipment, and can meet any comfort or process requirement. Each system is engineered to meet the exact needs of the individual plant.
- **Greater Simplicity.** Pneumatic control involves far fewer and much simpler components than anything else you can use. There are fewer components to check, fewer parts subject to failure.
- **Choice of Features.** Johnson makes the most complete line of pneumatic temperature, humidity and pressure control equipment to match your needs.
- **Reliable Performance.** Johnson Pneumatic Controls are unaffected by short circuits, electrical overloads, voltage variations and humidity. You get continuous, accurate control.
- **Complete Safety** . . . even in the presence of explosive gases, solvents, dusts and other hazardous materials.
- **Dependable Service** . . . Johnson maintains the oldest and largest service organization in the industry. Full time, factory trained service men are on duty in 105 direct branch offices and over 200 other cities.

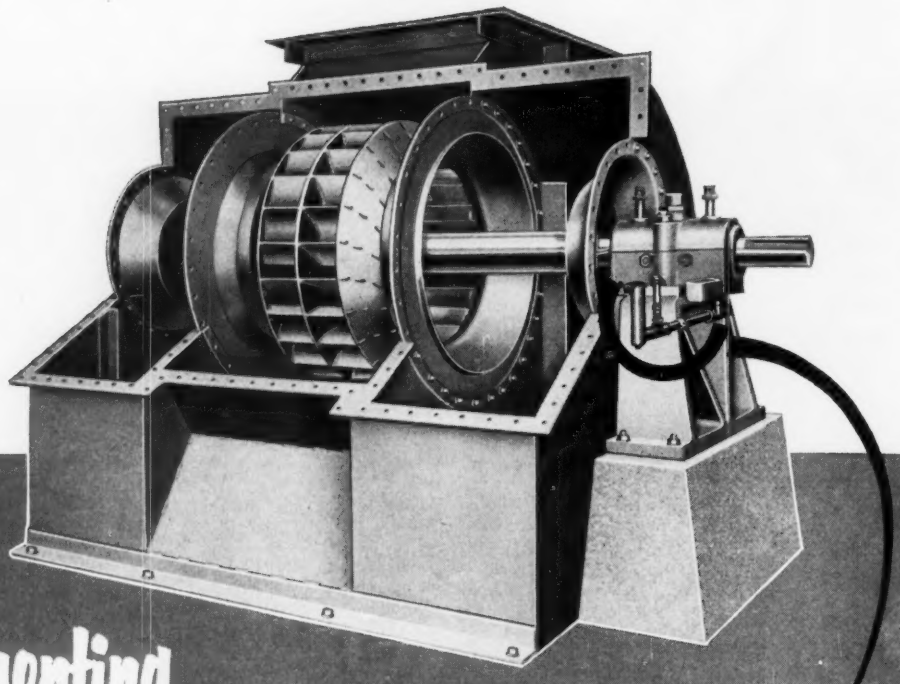
JOHNSON CONTROL

PNEUMATIC SYSTEMS

DESIGN • MANUFACTURE • INSTALLATION • SINCE 1885

TEMPERATURE CONTROL SYSTEMS FOR SCHOOLS, OFFICES, FACTORIES, STORES, HOSPITALS, HOTELS, PUBLIC BUILDINGS

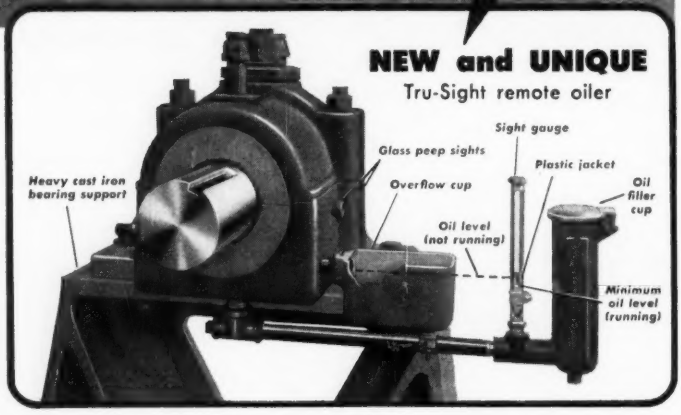
For more facts circle 222 on Reader Service Card, p 102



Presenting... Another of the features distinguishing CLARAGE MECHANICAL DRAFT FANS

You get more than extra-heavy construction, extra-long service life from a Clarage Fan. You now get a vastly superior oiling arrangement for the bearings — as shown on the right.

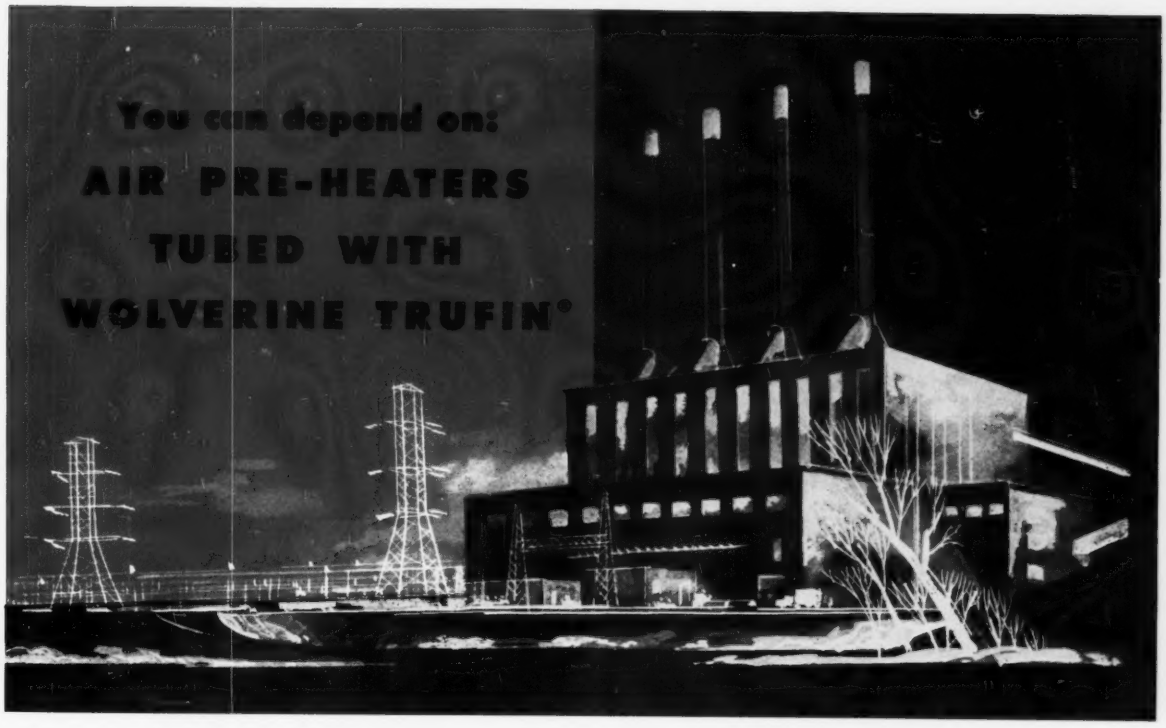
Learn more about the many features that make Clarage Fans stand-out performers in forced and induced draft service. Write us today for catalogs or contact nearest Clarage sales engineering office. CLARAGE FAN COMPANY, Kalamazoo, Mich.



Designed to simplify maintenance, this Clarage Oiler provides for accurate remote oil level indication when fan is running or not running . . . simplified oil level adjustment . . . quick filling . . . automatic overflow to prevent overfilling . . . cleanliness due to improved shaft seal effectiveness and use of overflow cup.

CLARAGE . . . dependable equipment for making air your servant

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

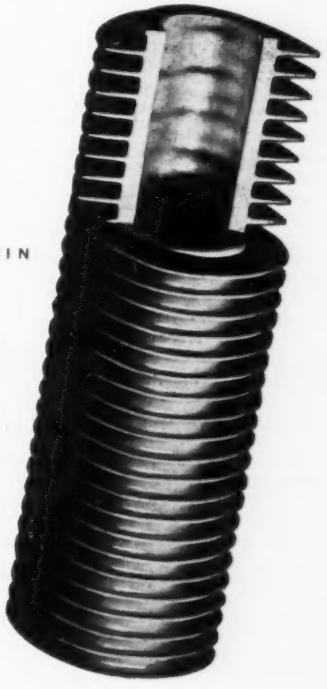


In many modern plants, engineers are gaining greater efficiency by specifying integrally finned Wolverine Trufin for use in combustion air pre-heaters.

The pre-heaters, currently going into a large power plant, are tubed with aluminum Trufin Type H/A. This tube saves weight—slashes costs. High-finned Trufin is also available in copper alloys and in a bimetallic form — an inner tube of copper bonded to an outer finned tube of aluminum.

Wolverine Trufin Type H/A has an outside to inside surface ratio of approximately 8:1. In this particular case, with pure condensing steam inside the tube, air is raised from 80°F. to 180°F. prior to entering the stack heaters.

If your company is contemplating the construction of a new power plant—or is expanding or modernizing—don't finalize pre-heater design until you get complete information about Wolverine Trufin and its benefits. Ask for the services of a Wolverine Technical Representative and write, too, for a free copy of the Trufin Catalog.



WOLVERINE TRUFIN
TYPE H/A

Wolverine Trufin is available in Canada through the Unifin Tube Division, London, Ontario.

CALUMET & HECLA, INC.
CALUMET DIVISION
URANIUM DIVISION
GOODMAN LUMBER DIVISION
WOLVERINE TUBE DIVISION
In Canada:
CALUMET & HECLA OF CANADA LIMITED
WOLVERINE TUBE DIVISION
CANADA VULCANIZER & EQUIPMENT CO. LTD.
UNIFIN TUBE DIVISION

WOLVERINE TUBE
DIVISION OF
CALUMET & HECLA, INC.
17268 Southfield Road
Allen Park, Michigan
Manufacturers of Quality Controlled Tubing and Extruded Aluminum Shapes

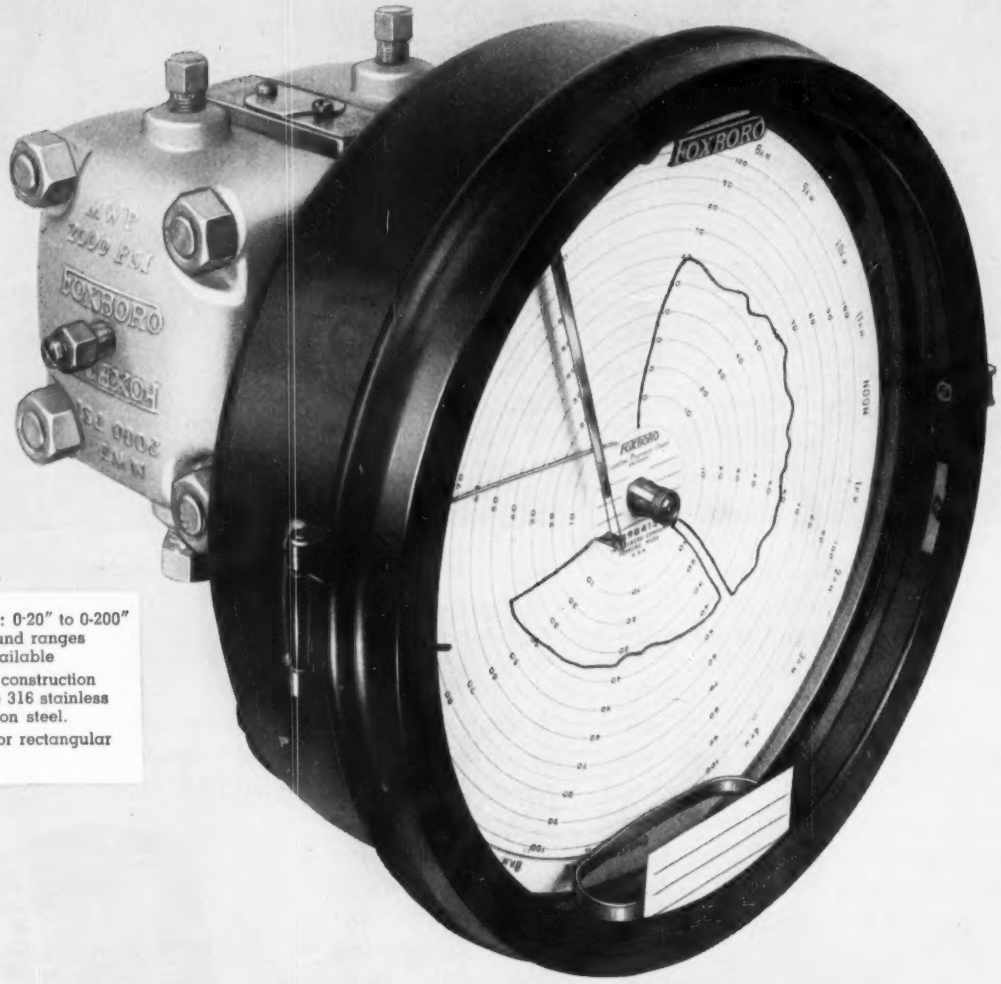
PLANTS IN DETROIT, MICHIGAN AND DECATUR, ALABAMA. SALES OFFICES IN PRINCIPAL CITIES

EXPORT DEPT. 13 E. 40TH ST., NEW YORK 16, N.Y.

For more facts circle 224 on Reader Service Card, p 102

For more facts circle 225 on Reader Service Card, p 102 ➤

NOW... a "Dry" Flow Meter with..

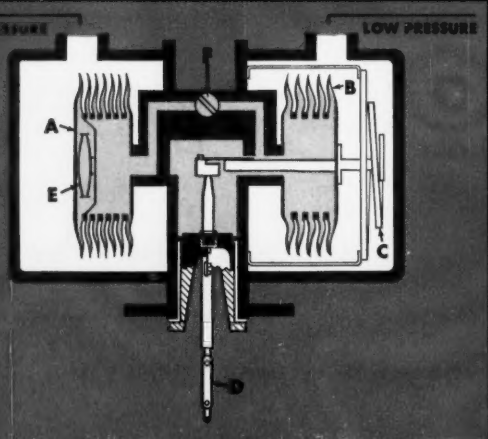


- Ranges: 0-20" to 0-200" Compound ranges also available
- Forged construction in Type 316 stainless or carbon steel.
- Round or rectangular cases.

..the new Foxboro Type 37 Diaphragm Meter

How It Works

In schematic drawing at right, areas shown in color represent a stable, non-freezing liquid. Any pressure increase in the high pressure chamber compresses Diaphragm Unit A, displacing its liquid and expanding Diaphragm Unit B until force of Range Spring C equals the difference between the forces on Diaphragm Units A and B. Linear motion of Diaphragm Unit B moves inner end of Drive Bar D — outer end moves correspondingly through the bellows-sealed flexure bar, driving pen arm. Built-in Temperature Compensator (E) proportionately adjusts diaphragm capacity as ambient temperature variations affect volume of filling fluid. External damping adjustment is shown at F.



• *complete overrange protection!*

• *sustained high accuracy!*

Now you can have mercuryless flow measurement for a wide range of differential pressures — at static pressures up to 2000 psi — with greater safety and dependability than ever before!

The new Foxboro Type 37 Diaphragm Meter not only combines unmatched ruggedness and precision in a dry meter — it's by far the easiest to adjust and maintain. And it does away with zero drift problems, once and for all!

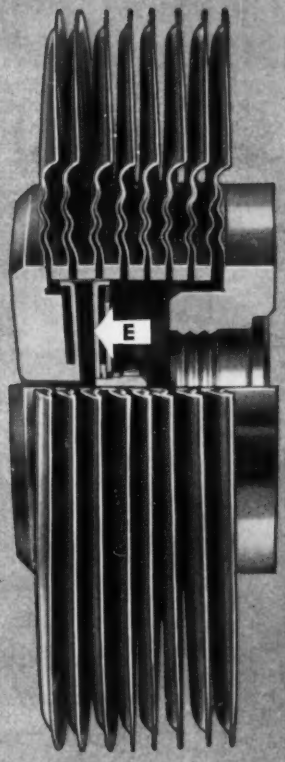
Expansible, Type 316 S.S. diaphragm elements respond to changes in pressure with unmatched sensitivity, yet are completely immune to overrange up to full static pressure! A unique packless drive bar precisely transmits linear motion to the pen arm. Range-changing is easy, due to new twin-spiral spring design. Wide range damping is externally adjustable under pressure. And the Type 37 is self-compensating for temperature changes in all differential ranges.

Get full details on this high utility, completely dependable dry flow meter. Arrange for a demonstration with your nearby Foxboro Field Engineer, or write **The Foxboro Company, 68z Neponset Ave., Foxboro, Mass., U.S.A.**

FOXBORO

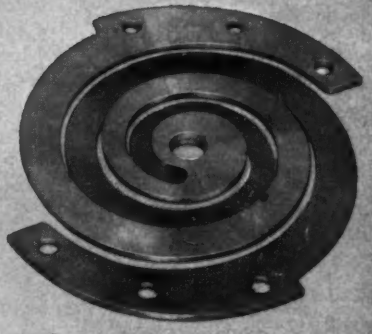
REG. U.S. PAT. OFF.

FIRST IN FLOW METERING



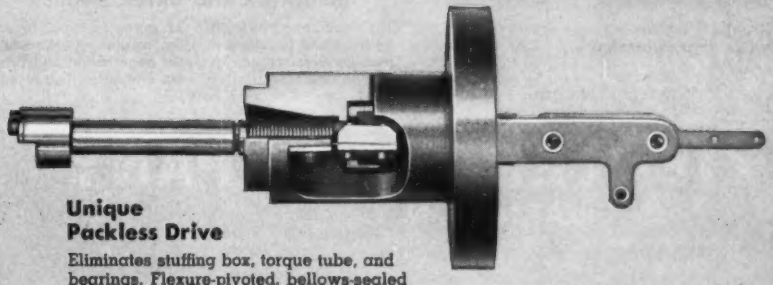
Exclusive Diaphragm Elements

Type 316 S.S. diaphragm units in both high and low pressure chambers provide greatest linearity and freedom from hysteresis; nesting design and integral spacer rings provide safe, positive, overrange protection. Temperature compensation (E) is built into diaphragm assembly . . . never requires change or adjustment.



Exclusive Range Springs

Heavy gauge Ni-Span C alloy, twin-spiral springs provide high sensitivity with lasting accuracy. Readily accessible . . . range changes are easily made, in minutes!



Unique Packless Drive

Eliminates stuffing box, torque tube, and bearings. Flexure-pivoted, bellows-sealed drive bar transmits diaphragm's linear motion to the pen arm with unequalled sensitivity *and undiminished power.* Seal for flexure pivot is a tough, flexible bellows.

for complete...sure...permanent...low cost

UNDERGROUND HOT PIPE PROTECTION

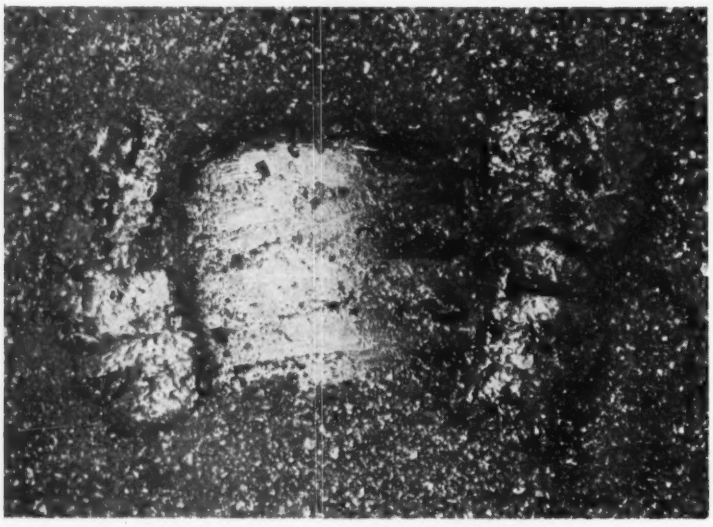
Specify and Use.....

TRI-SUL-ITE

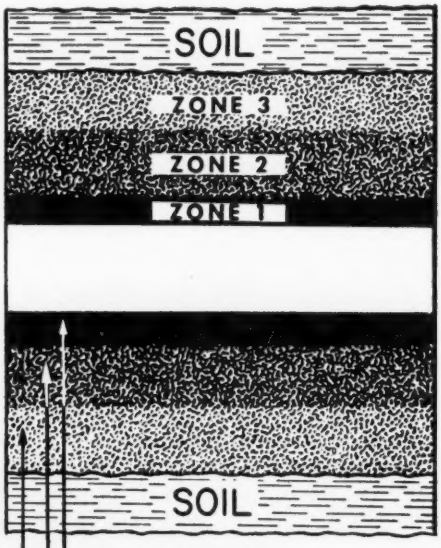
3-WAY PROTECTION SYSTEM *

THE ZIEGLER GILSONITE MINERAL

Looking for an underground piping system that's free from excessive heat loss...yet gives the greatest protection possible from corrosive soil conditions? A system with a low installation cost and minimum maintenance expense? Then TRI-SUL-ITE 3-way protection system is your answer. TRI-SUL-ITE installations have proven to be the speediest...easiest...surest underground pipe protection. TRI-SUL-ITE, a specially selected gilsonite, is poured under and around all pipes in the trench. After proper curing, it forms three zones of protection against water, corrosion and heat loss.



Close-up photo illustrates the plastic zone of TRI-SUL-ITE peeled back to show excellent adhesion for pipe protection.



*** ZONE 1 PROTECTION: PERMANENT WATER BARRIER**

The first zone of TRI-SUL-ITE adjacent to the pipe, fuses from pipe heat into an impermeable, waterproof coating. It resists normal soil acids and alkalis. When it is plastic the pipe movement is contained within this zone. The first zone of TRI-SUL-ITE protection gives positive assurance that water cannot follow the grade of the pipe.

*** ZONE 2 PROTECTION: EXCELLENT INSULATOR**

The second zone consists of the edges of the TRI-SUL-ITE granules fused to isolate the air spaces, resulting in a highly effective insulator which minimizes heat losses to the soil.

*** ZONE 3 PROTECTION: INSULATOR AND WATER BARRIER**

The third zone of TRI-SUL-ITE granules is not fused by heat and provides maxium insulating efficiency plus good resistance to water penetration and protection against surface shocks and subsoil stresses.

Write for complete literature.

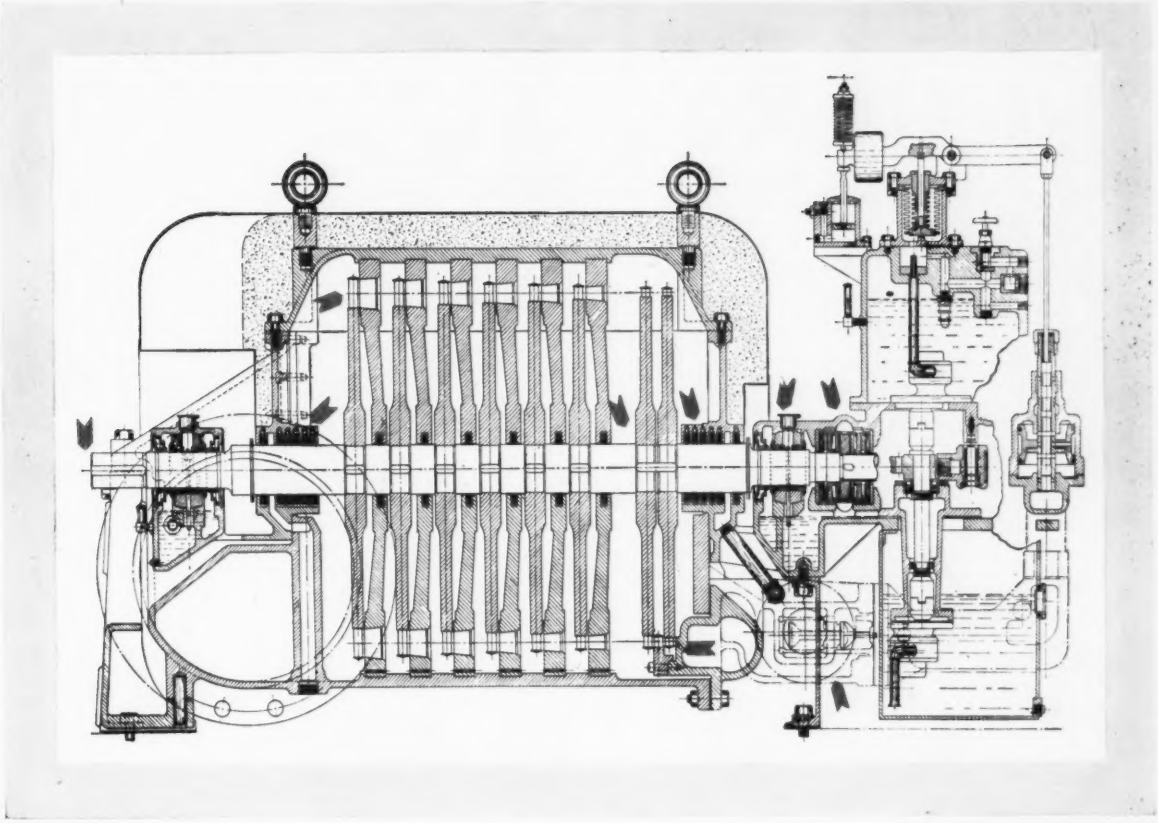
G. S. ZIEGLER & COMPANY

GREAT NECK, N. Y.

Agents in Principal Cities Throughout the United States and Canada.

MINES: "CASTLE PEAK," "LITTLE BONANZA," "LITTLE EMMA"

For more facts circle 226 on Reader Service Card, p 102



ANOTHER INSIDE STORY OF THE UNIVERSAL ACCEPTANCE OF MURRAY MULTI-STAGE TURBINES IN THE MECHANICAL DRIVE FIELD

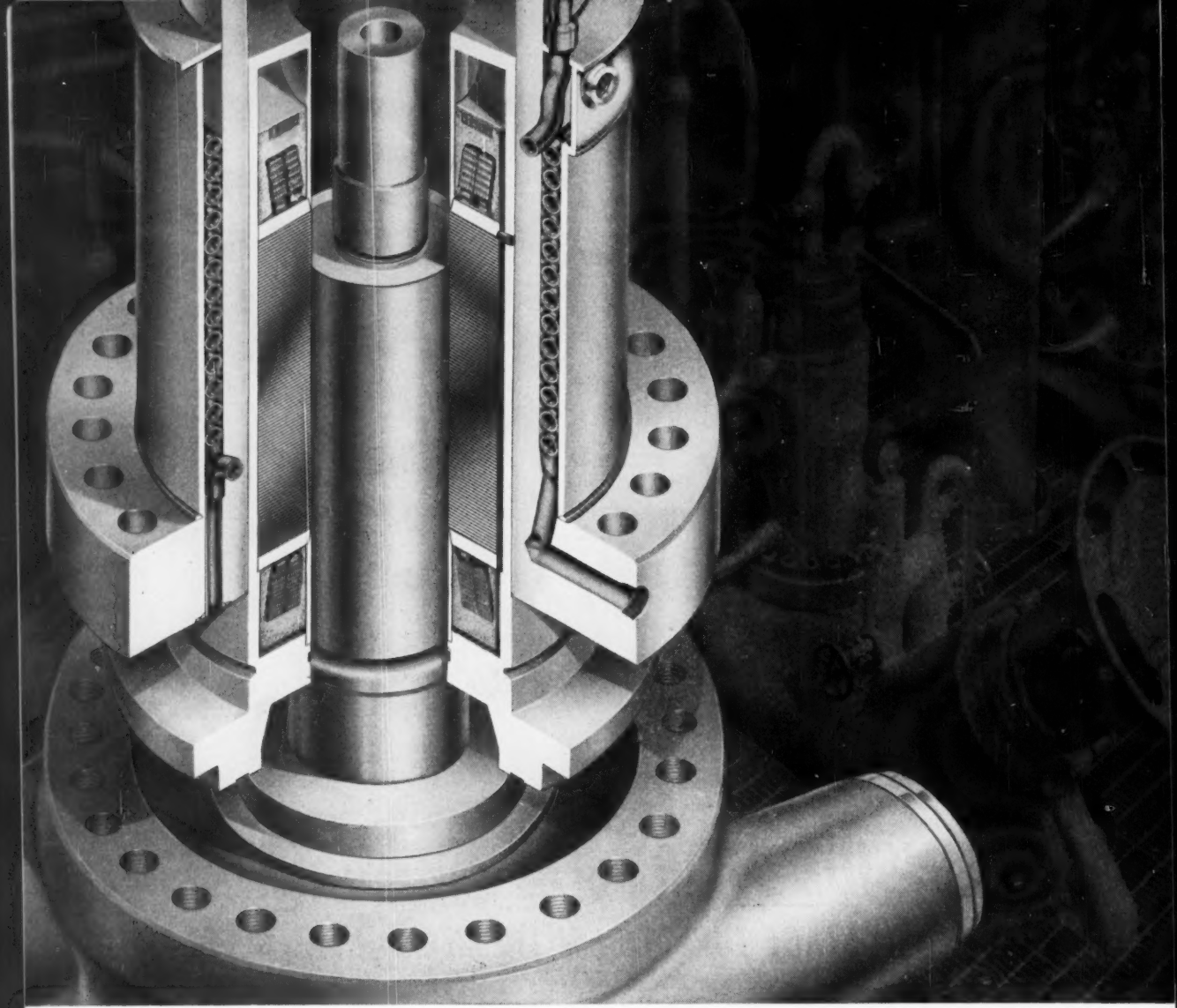
- Husky accurately machined shaft.
- Discs shrunk and keyed in place.
- Stainless steel nozzles and blading throughout.
- Spherical seated sleeve bearings.
- Kingsbury thrust bearing.
- Center line support.
- Carbon ring gland seals.
- Double seated balanced governor valve — stellited.
- Choice of speed governors from simple mechanical type to precision oil relay.
- Bolt type overspeed trip governor.
- Steam conditions to 600 PSIG and 750°F.
- Condensing or non-condensing.

Our nearest representative will gladly help you solve your mechanical drive turbine requirements. Just write to Murray Iron Works Company, Burlington, Iowa, for his name.

Murray
TURBINES

MURRAY IRON WORKS COMPANY • BURLINGTON, IOWA
Builders of Steam Power Equipment for Nearly a Century

For more facts circle 227 on Reader Service Card, p 102



New Removable Stator Design, "Canned" Motor-Pump (exploded cutaway view)

For better boiler circulation...specify Westinghouse "canned" motor-pumps

Controlled circulation boilers equipped with Westinghouse "canned" motor-pumps have a higher unit efficiency, are more reliable and are easier to operate and maintain.

The pump and motor casings completely enclose the pump shafting... Conventional shaft seals and complicated seal injection systems are eliminated.

Watertight Inconel cans encase the rotor and stator . . . All windings are dry and clean for years of trouble-free operation.

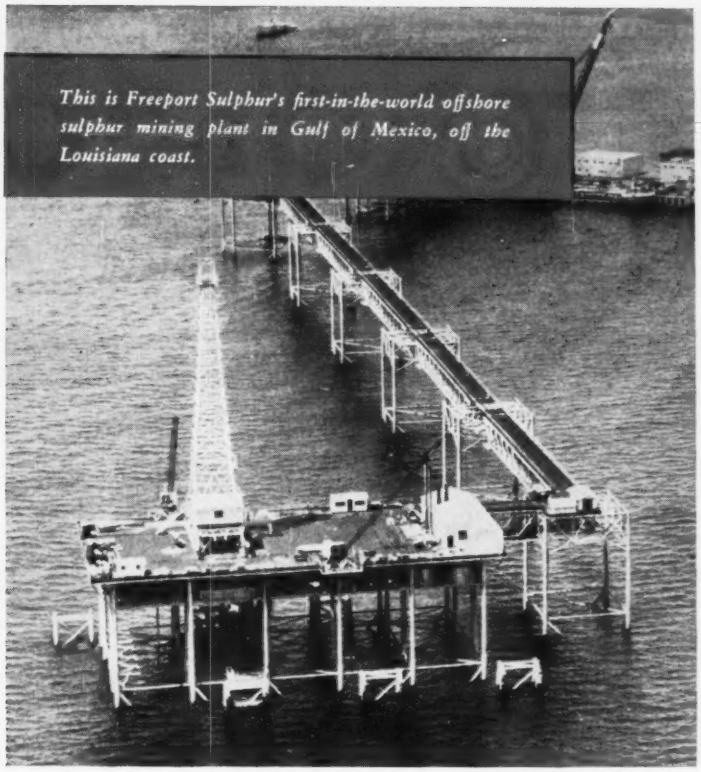
New unit construction of stator and rotor permits easy, fast (24-hour), in-your-shop inspection, overhaul and repair... Reliability and availability of pumps are at a maximum.

For more information on how Westinghouse "canned" motor-pumps will improve controlled circulation boiler performance, contact your Westinghouse sales engineer, or write Westinghouse Electric Corporation, Atomic Equipment Department, P. O. Box 217, Cheswick, Pa. J-57011

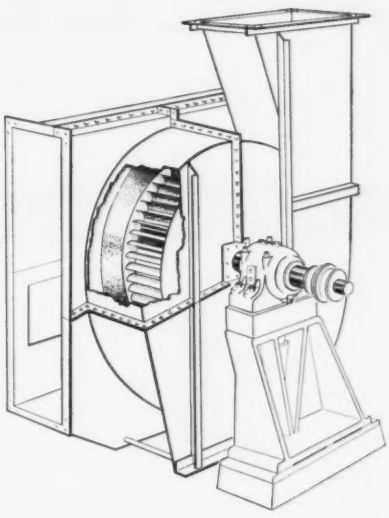
YOU CAN BE SURE...IF IT'S Westinghouse

WATCH "WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS" CBS TV MONDAYS

For more facts circle 228 on Reader Service Card, p 102

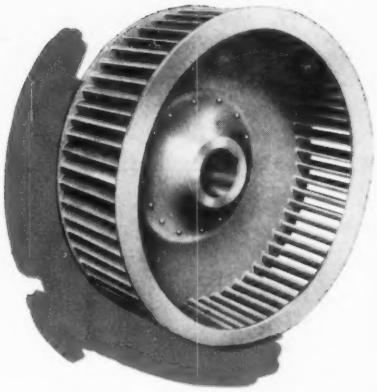


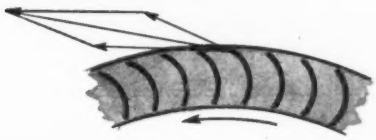
This is Freeport Sulphur's first-in-the-world offshore sulphur mining plant in Gulf of Mexico, off the Louisiana coast.



This is Green's MC type fan, 4 of which were supplied to Freeport Sulphur—each with 54" wheel, producing 67,800 CFM against 18" S.P. at 715°.

FREEPORT SULPHUR'S doing it for the first time in the world! and Green MC type fans will help this gigantic air lift!





It's the forward curve at BOTH tip and heel of fan blades that does the job on Green MC type fans.

Freeport Sulphur had a tough engineering problem.

For their world's first offshore sulphur mining operation, Freeport Sulphur has to compress truly tremendous air volume to air lift liquid sulphur to the surface. Fans are needed for the steam operating unit compressing this air.

Rugged, dependable fans are required. Also, fans that need but a minimum of working space.

Where did Freeport Sulphur get such fans?

Easy — they ordered Green MC type fans. These fans are not only rugged, but the MC is the smallest fan that can be used to perform any required job.

You, too, might solve a vexing engineering problem by calling on Green.

Green

THE GREEN FUEL ECONOMIZER CO., INC.,

BEACON 3, NEW YORK

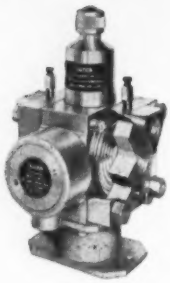
For more facts circle 229 on Reader Service Card, p 102

Taylor Instrument Companies

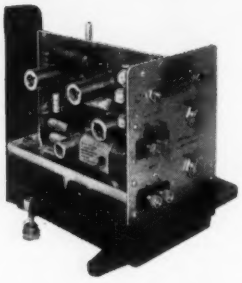
ELECTRONIC

with all the outstanding features of

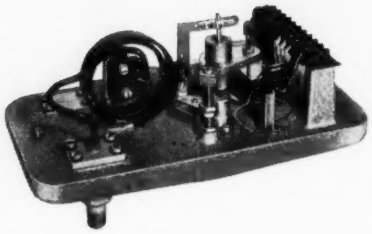
INSTANTANEOUS SENSING AND TRANSMITTING UNITS



707T DP Transmitter. It provides direct conversion from differential pressure to an AC signal. No maintenance . . . insensitive to vibration . . . self-draining and venting . . . positive over-range protection to 1500 psi . . . no process fluid in contact with internal parts, double stainless diaphragm seal between process and electrical components . . . no stuffing box, no bending members, no pivots, no flexible diaphragms nor torque tube seals. No vacuum tubes, no transistors—only a simple differential transformer. Highly linear adjustable silicone damping. Perfect for all flow applications. External zero, with wide range of zero suppression. Designed for use in Class I, Group D, Division I areas.



700T Potentiometer Transmitter. Unsurpassed for sensing and transmitting Temperatures (either thermocouple or resistance elements), Load, Speed, pH, or other millivolt signals. Electronic balancing eliminates the need for slide wires, batteries, standard cells or moving parts. Continuous vernier adjustment of span or zero is simplest on the market.
Interchangeable plug-in service "cans" permit quick adaptation of one instrument for use with different primary elements. Amplifier plugs in for simple servicing. Infinite sensitivity to the input signal. Weatherproof case permits field mounting. Users consider it the finest potentiometer transmitter available.



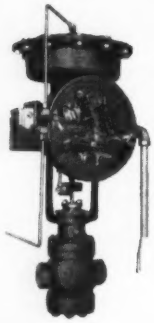
705T Pressure Transmitter. Bourdon tube senses pressure changes and moves the core of a differential transformer to change its electrical output. A simple, extremely dependable unit, built for many years of trouble-free service. Simple span and zero adjustments. Pressure ranges from absolute to 2000 psi.

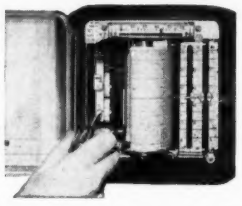
• • •

See your Taylor Field Engineer for full details or write for Bulletin. Taylor Instrument Companies, Rochester, N. Y., and Toronto, Ontario.

VALVE POSITIONER

A true electro-pneumatic valve positioner, permits full utilization of the superior performance of electronic control, coupled with the power and smooth throttling action of pneumatic diaphragm motors. Pneumatic high-capacity, leakless booster relay is easily accessible for maintenance without exposing the electrical system. Unmatched stability due to powerful balanced armature reduces susceptibility to shock and vibration to a minimum. Designed for Class I, Group D, Division I areas.





1. Front Adjustments and all the features of the famous 90J Transcope Pneumatic Recorder. With chart, pen and set-point side-by-side (as in Transcope Pneumatic Recording Controllers) all pertinent process information is immediately visualized. Hence operators make fewer mistakes. All available in one 6″ x 6″ cutout.

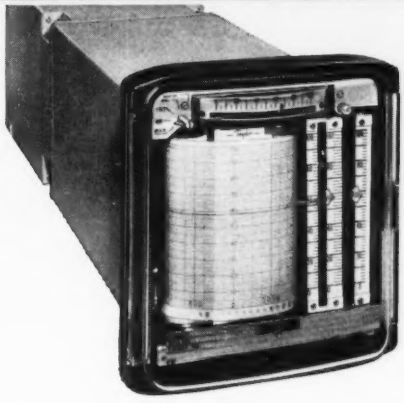
Taylor Instruments

sets new standards in

INSTRUMENTS

the highly successful TRANSCOPE* line!

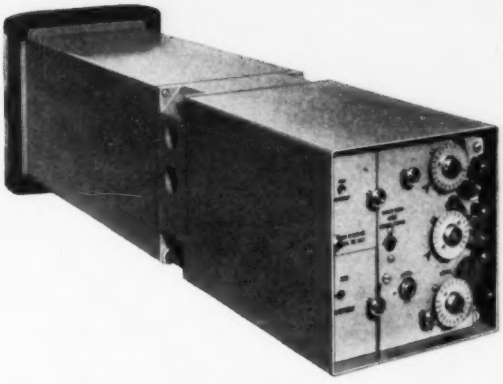
AC or DC RECORDER



Parallels electronically all the features of the TRANSCOPE Pneumatic Recorder that have won such wide acclaim. Positive, precise pen positioning provided by actual servo-motor, hundreds of times more powerful than meter type movement. Control settings and adjustments can be made from front or rear of case. Recorder can be removed without disturbing process control. Bumpless manual-to-automatic transfer is obtained without manual matching of set point and process. Plug-in Set Point Transmitter permits uninterrupted control.

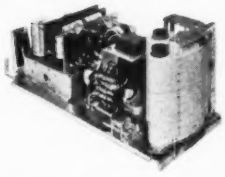
All transistorized (solid state), the 701J Recorder is unaffected by ±10% line voltage variation; thus there is no need for an expensive constant voltage source. All principal assemblies and sub-assemblies are plug-in type for flexibility and easy accessibility.

AC or DC CONTROLLER

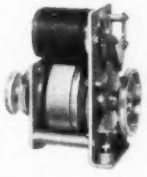


Embodies all the advantages of the most advanced control circuits. The unique diode limiter circuit permits even the two-response controllers to eliminate overpeaking on most applications. It is effective *at all times,* whether the variable is approaching control point from above or below; on changes in set point; following major process disturbances; or on start-up.

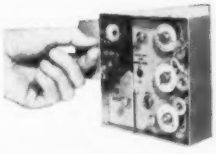
Interchangeable, plug-in assemblies permit conversion to either fast or standard reset and two-response or three-response controllers. Unparalleled rangeability makes this a universal controller. Unaffected by line voltage changes up to ±10%. Controller signal gives multiple valve operation. Output signal from 1-5 Ma feeds into any load from 0-10,000 Ohms. Plug-in assemblies: control responses, operational amplifier, AC/DC Converter, DC reference supply and controller.



2. Interchangeable Recorder Slide. Completely transistorized. Unaffected by a supply voltage change up to ±10%.



3. Powerful Servo Motor gives more precise pen positioning than ever before. More accurate records.



4. Plug-in Controller Sub-Assemblies. Printed circuit boards, mercury bottle disconnect switch.

5. Extremely Stable Controller Amplifier, utilizing latest design techniques and premium components.

*Reg. U.S. Pat. Off.

MEAN ACCURACY FIRST

For more facts circle 230 on Reader Service Card, p 102

J&L welded boiler tubing is being used by Wickes Boiler Co. for a wide variety of products, including these boiler pressure assemblies.

"We can rely on J&L welded boiler tubes to have uniformly sound physical properties"

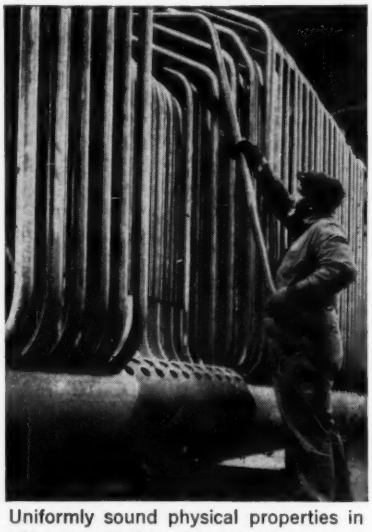
"They meet all of our rigid production and quality control requirements," says Wickes Boiler Company official

The Wickes Boiler Company of Saginaw, Mich., a division of the Wickes Corp., has found J&L electric-resistance-welded pressure tubing to be well adapted to its needs, reports D. H. Barnes, division president. J&L boiler tubing has been used in a wide variety of Wickes products, including the newest Wickes Type-A water tube steam generator, the largest shop assembled generator of its type ever built. This generator is now in use in a large steel plant.

Wickes has custom-designed and built boilers—featuring J&L pressure tubing—for a variety of installations, including hospitals and chemical refineries, schools and automotive plants, military posts and food processors.

If your firm makes a product involving pressure tubing, investigate J&L's service-proven steel tubing. J&L pressure tubing has been used for closed-type feedwater heaters, industrial hot water heaters, cooling water heat exchangers, and package steam generators, to mention only a few applications.

For more information, call your J&L representative. Or write to Jones & Laughlin Steel Corp., 3 Gateway Center, Pittsburgh 30, Pa.



Uniformly sound physical properties in J&L welded boiler tubing eliminate bending problems and assure trouble-free assembly of tubular components.

The exciting new J&L

Jones & Laughlin Steel Corporation

PITTSBURGH, PENNSYLVANIA

For more facts circle 231 on Reader Service Card, p 102

LOUIS N ROWLEY, EDITOR • FEBRUARY 1959 • ESTABLISHED 1882 **Power**

Where do we go from here?

Now that we have clearly begun to climb out of the "recession," it is only natural to wonder what the long-run picture will be like. Will we resume the dynamic growth that marked the recent past? And, more particularly, how will the power services fare in the years ahead?

Right here, I'd like to state my conviction that the long-term prospect is very bright indeed, particularly for power-service engineers. This confidence rests on a fundamental fact that should never be overlooked: in the long run, U.S. history shows a close relationship between energy conversion, which is *our* business, and the growth of the national economy.

This relationship has been stressed before, on this page and elsewhere, buttressed by a number of statistical studies. For example, one estimate indicates that the national economy in 1940 was 16.5 times bigger than it was in 1850. And, during the same period, total energy consumption increased by an almost identical amount.

The reasons for this close relationship are no mystery to us whose lifework is the conversion of energy. Higher living standards can only come from higher productivity. And we in the power field know that the key to higher productivity is the substitution of machine power for muscle.

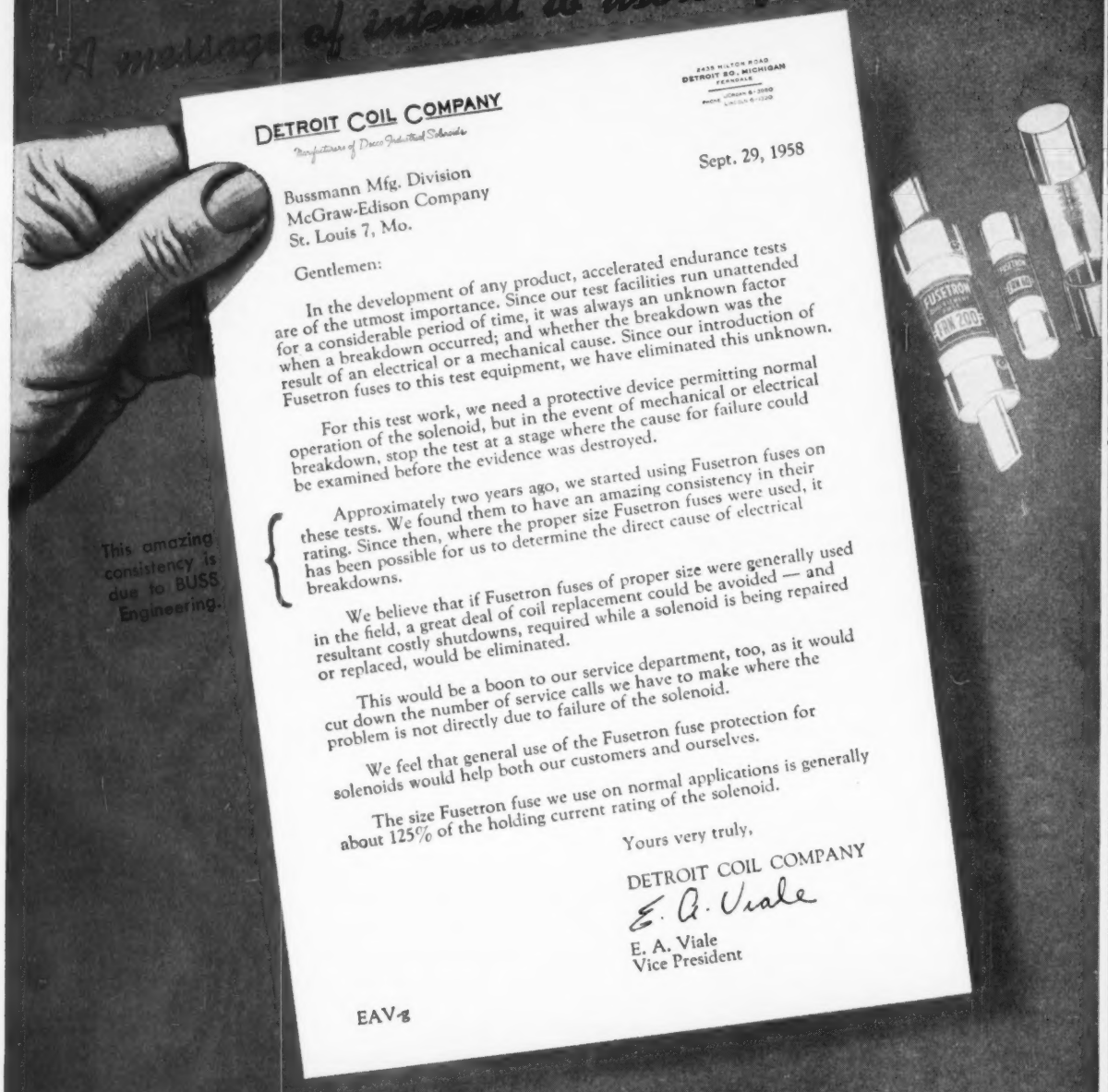
Just as keenly, we are aware of how one form of energy—electricity—has grown in relative importance. We have seen how electricity — that supremely versatile and convenient energy carrier —has given the power services the reach and flexibility needed to play their full role in American industry. And whether we generate or purchase it, the distribution and application of electricity shapes up as an ever bigger part of our increasingly broad power-service responsibilities.

Thus it isn't surprising to see what has happened to one yardstick of this electrical trend—sales of electric energy. In the past ten years, consumption of electricity, as measured by sales, has increased at a faster rate than consumption of all other forms of energy, and has, moreover, increased at a rate several times faster than the national economy as a whole.

Most experts expect this growth rate to continue. Thus the business of suppling electric energy—and the business of applying it—looms as one of the top growth industries of the next decade. Even in an economy that moved ahead only slowly, this would promise a good power-service future. But there is scant reason to fear a lethargic economy in the years ahead. The figures differ as to precise rates, but virtually all authorities forecast sharp growth for the total economy in the decade beginning in 1960.

What does it all add up to? Vigorous growth on all fronts. Even more vigorous growth for the vital power services. And challenging opportunities for the engineers who design and manage power-service systems and for the manufacturers who supply power-field equipment and materials.

A message of interest to users of Solenoids



DETROIT COIL COMPANY
Manufacturers of Direct Industrial Solenoids

3435 HALTON ROAD
DETROIT 20, MICHIGAN
FERNDALE
PHONE JORDAN 8-2080
LINCOLN 8-1020

Sept. 29, 1958

Bussmann Mfg. Division
McGraw-Edison Company
St. Louis 7, Mo.

Gentlemen:

In the development of any product, accelerated endurance tests are of the utmost importance. Since our test facilities run unattended for a considerable period of time, it was always an unknown factor when a breakdown occurred; and whether the breakdown was the result of an electrical or a mechanical cause. Since our introduction of Fusetron fuses to this test equipment, we have eliminated this unknown.

For this test work, we need a protective device permitting normal operation of the solenoid, but in the event of mechanical or electrical breakdown, stop the test at a stage where the cause for failure could be examined before the evidence was destroyed.

Approximately two years ago, we started using Fusetron fuses on these tests. We found them to have an amazing consistency in their rating. Since then, where the proper size Fusetron fuses were used, it has been possible for us to determine the direct cause of electrical breakdowns.

We believe that if Fusetron fuses of proper size were generally used in the field, a great deal of coil replacement could be avoided — and resultant costly shutdowns, required while a solenoid is being repaired or replaced, would be eliminated.

This would be a boon to our service department, too, as it would cut down the number of service calls we have to make where the problem is not directly due to failure of the solenoid.

We feel that general use of the Fusetron fuse protection for solenoids would help both our customers and ourselves.

The size Fusetron fuse we use on normal applications is generally about 125% of the holding current rating of the solenoid.

Yours very truly,

DETROIT COIL COMPANY

E. A. Viale

E. A. Viale
Vice President

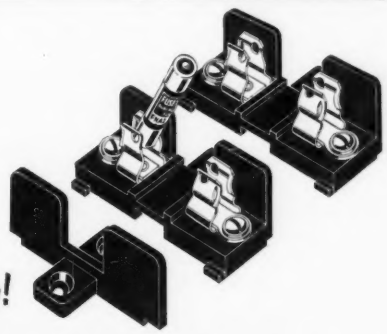
EAV:z

This amazing consistency is due to BUSS Engineering.

"A Great Deal of Coil Replacement could be avoided, and Resultant Costly Shutdowns Eliminated by Protecting Solenoids *with* FUSETRON FUSES."

E. A. Viale, VICE PRESIDENT
DETROIT COIL COMPANY

Protecting solenoids or other electrical equipment with FUSETRON Fuses—gives you greater safety, dependability and money-savings!



The BUSS Add-On Fuse Block for the protection of solenoids or Small Motors on Multi-Circuit Equipment

The BUSS Add-On fuse block makes it easy to protect equipment of any kind where a number of solenoids or motors are used.

Blocks are made up of single pole fuse blocks that interlock into a unit fuse block of any number of poles.

Poles may be added or removed . . . to either end of assembled fuse block. This makes it simple to have a fuse block of just the number of poles needed and to fit the block to available space.

Each fuse can be used as a circuit disconnect.
Specially designed fuse clips permit one end of fuse to be removed from clip and fuse raised to right angle to block where it is held firmly in position — see picture above.

When working on machine this makes it quick to identify circuit that is open — and it assures that proper fuse will be put back in right circuit.

Write for BUSS Bulletin BL-1.

BUSS and FUSETRON fuses are available to fit these fuse blocks in ampere sizes up to 30 and for voltages up to 250. Write for BUSS Bulletin SFB.

FUSETRON dual-element fuses provide 10 point protection against electrical troubles—unlike circuit breakers or ordinary fuses which, except in rare cases, protect only against short-circuits.

Fusetron Fuses remain safe — with no maintenance or recalibration required. They are calibrated at the factory by engineers. Once properly installed, they require no inspection and resulting downtime necessary on mechanically operated devices. There are no hinges, pivots or contacts to stick or get out of order. Dust, corrosion or oxidation cannot increase a Fusetron fuse's capacity or lengthen its blowing time.

After years of inactivity, a Fusetron fuse will give the same safe, dependable protection if called upon to open as it would have on the day it was installed.

For more information, write for . . . Bulletin FIS on Fusetron Fuses.

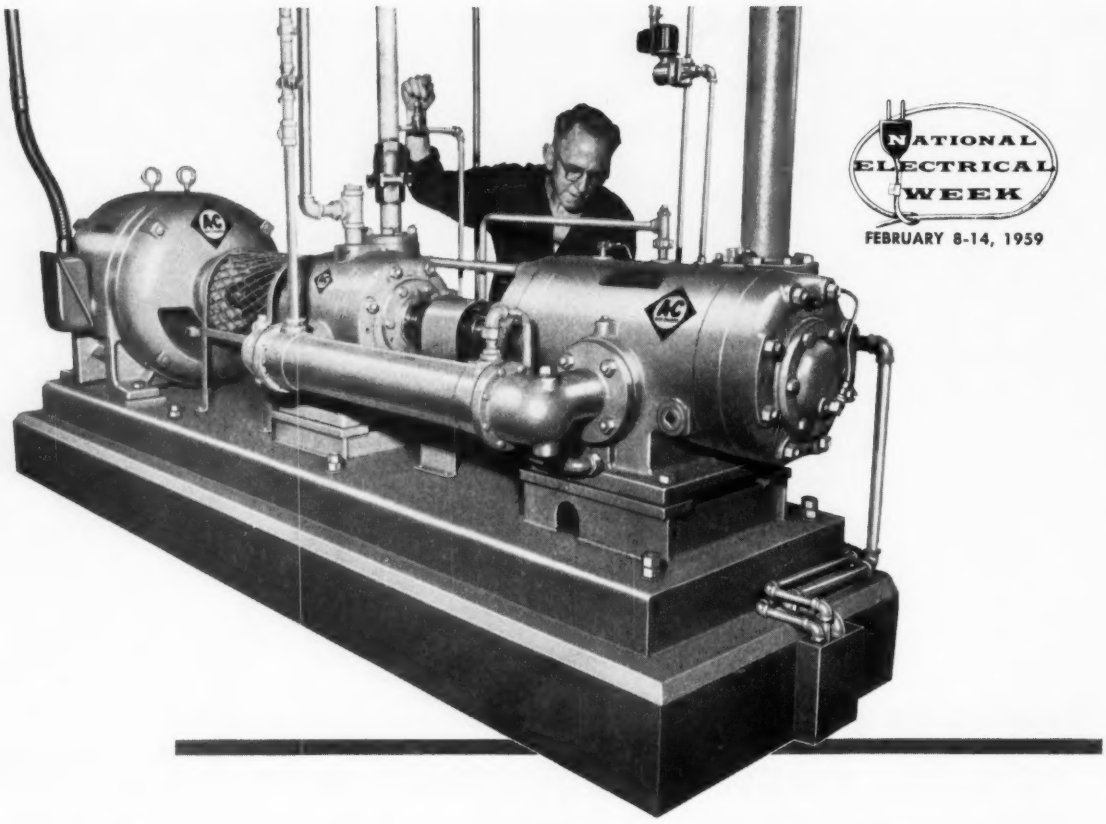
Bussmann Mfg. Division, McGraw-Edison Co., St. Louis 7, Mo.

159

Play Safe! Install Fusetron dual-element fuses throughout entire Electrical System.

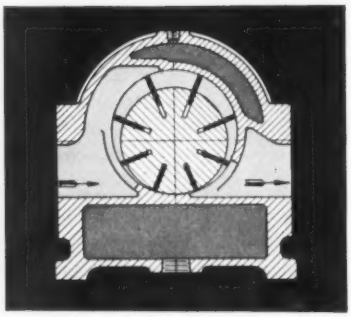
FUSETRON · TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION · BUSS · McGRAW EDISON · BUSSMANN MFG. DIVISION · St. Louis 7, Mo.

For more facts circle 232 on Reader Service Card, p 102

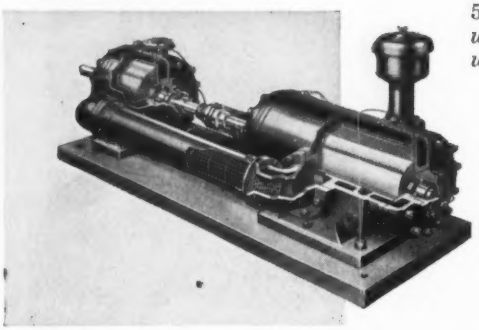


NATIONAL ELECTRICAL WEEK
FEBRUARY 8-14, 1959

Smooth operation—Prolonged efficiency



Simple operation — centrifugal force holds blades against sidewall to form air chamber.



with Ro-Flo compressors for plant air supply

Rotary operation is smooth, vibrationless. Compare this to the pounding and shock inherent in reciprocating compressors.

That's why *Ro-Flo* compressors eliminate the cost of heavy foundations. A slab is enough. Smaller units are bolted to the floor. And "like-new" efficiency is maintained for years — because rotor blades compensate for wear automatically.

No pistons, valves or connecting rods to cause trouble. Only two wearing parts in the *Ro-Flo* compressor. All this means far less maintenance.

Two-stage units range from 250 to 1800 cfm, from 60 to 125 lb gauge. Single-stage units from 40 to 3000 cfm, up to 50 lb gauge. *Ask your A-C man for descriptive literature, or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin.*

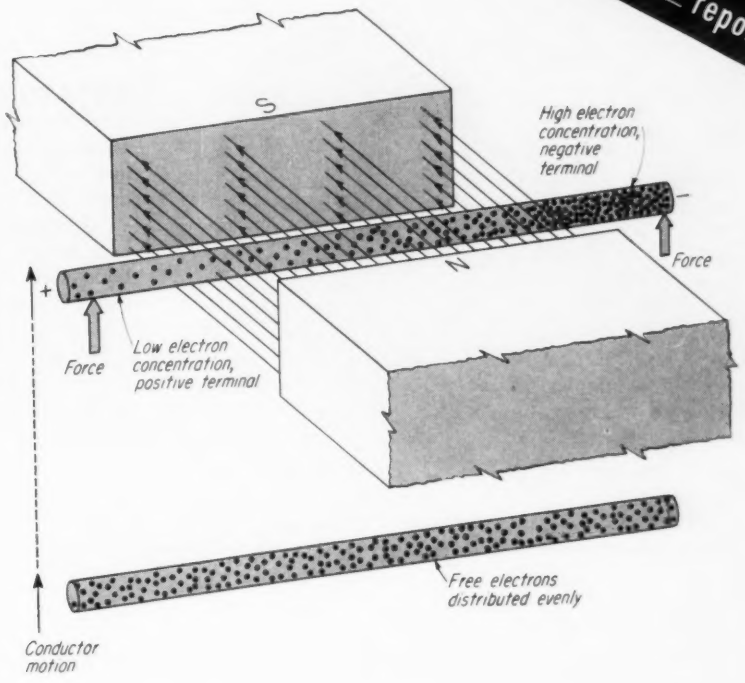
Ro-Flo is an Allis-Chalmers trademark.

ALLIS-CHALMERS

A-5899

Design and equipment application section

B G A SKROTZKI
Associate Editor in Charge



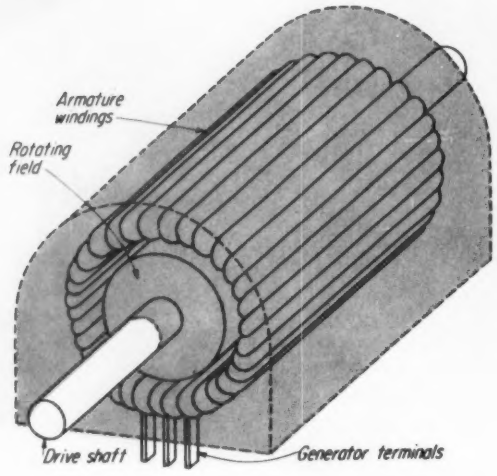
Sweeping conductors through magnetic fields has been the hard-worked method of generating vast quantities of electricity in our century. Batteries have played their part faithfully in producing low-voltage energy and storing energy for medium-voltage short-term emergency electric supply. Despite these time-tried and proven methods, the unrelenting search goes on for . . .

By B G A SKROTZKI
Associate Editor

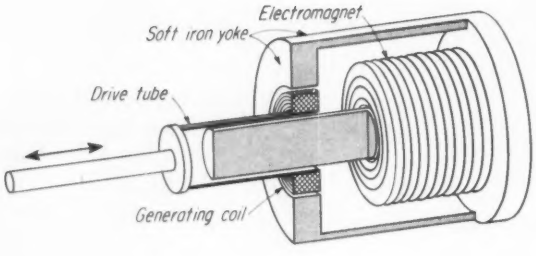
More ways to generate electricity

- Rotating induction
- Oscillating induction
- Variable reluctance
- Piezoelectric
- Magnetostrictive
- Electrostatic
- Electrokinetic
- Ion-permeable membranes
- Fuel cells
- Thermomagnetic
- Pyroelectricity
- Thermionic emission
- Thermocouples
- Solar batteries
- Nuclear reactions

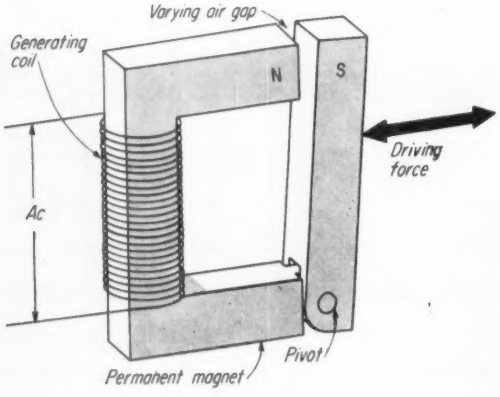
We produce most of our electrical energy



ROTATING INDUCTION is our most highly developed method of generating electrical energy at all amperages and voltages. Our well-known generators and alternators absorb mechanical work through their shafts to produce direct and alternating-current electricity at high overall efficiency. Generators may be built in a wide variety of designs, from slow to high speed, from two to many poles, from fractional-kw to 350-mw capacity, with 500-mw units likely in the future. They have rotating fields or armatures driven by steam or gas or water turbines, by i-c engines or steam engines. Major efforts being made to improve cooling will lead to more compact designs operating at higher efficiency and greater outputs.

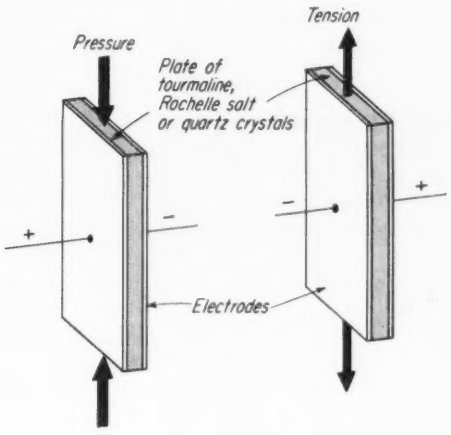


OSCILLATING INDUCTION generators like our present rotating types would change mechanical energy to electrical energy by moving conductors and magnetic fields relative to each other. But instead of using rotary motion these generators would use a relatively oscillating motion between field and conductor. The principle has been widely applied to telephone equipment, microphones and phonograph pickups. Small laboratory power generators of the type shown, left, have been tested. At 20 oscillations per second a generator developed 3.5 volts ac to produce an output of 1.2 watts. The unit weighed 35 lb per watt. The researchers believe they can generate several thousand volts at good efficiency.

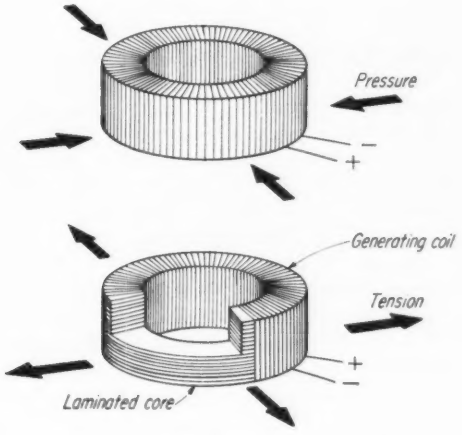


VARIABLE RELUCTANCE generators have been proposed that would vary the air gap in a magnetic circuit. This would change the magnetic field strength and so sweep the lines of force over the conductors coiled on the magnet. This again converts mechanical energy to electrical. This generator may use more turns than the one above without increasing the weight of the moving element. But the operation of this unit introduces magnetic losses not experienced by other generators. The moving mass makes this basically a low-frequency generator. The specific weight and volume of the generator are expected to compare favorably with conventional types. Overall efficiency should run as high as 90%.

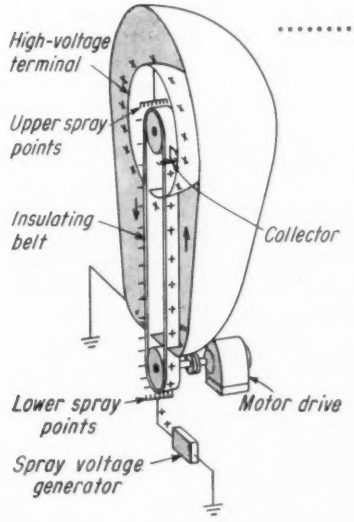
from mechanical energy at good efficiency



PIEZOELECTRIC generation uses crystals to produce minute amounts of electric energy. Compressing, stretching, twisting or bending certain crystals of Rochelle salt, barium titanate or like compounds makes their opposite faces become oppositely charged electrically. Reversing the deformation reverses the polarity. When we compress these crystals by vibration at 10,000 to 100,000 cycles per second they may generate as much as 10 watts per sq cm at efficiencies as high as 90% under optimum conditions. These crystals are used to convert mechanical energy into electrical in microphones, phonograph pickups, hydrophones and vibration meters. New materials may offer improved performance and larger outputs.

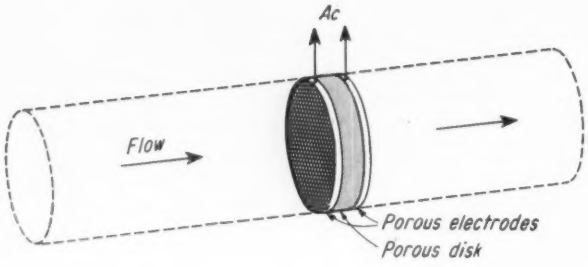


MAGNETOSTRICTION generators have been proposed but no actual performance has been reported. Like piezoelectric generators they will produce only minute amounts of electric energy. Mechanical deformation of materials like cobalt, nickel and Permalloy (45% Ni, 55% Fe) changes their magnetic characteristics. Vibrating any of these materials makes their magnetic fields change, so if we place conducting coils around these materials they can generate an electric current. Some proposed arrangements are shown at left. The most likely application of this effect would be in picking up acoustic waves in a liquid and converting them to electric signals for communication or warning.

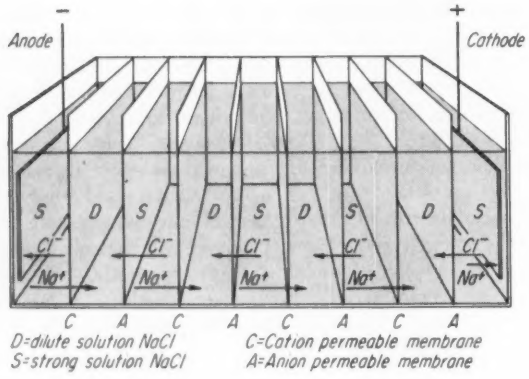


ELECTROSTATIC generators are the oldest forms of equipment for producing electric energy. They have played a very important part in our investigation of nuclear reactions, perhaps the most outstanding one being the Van de Graaff generator. These special-purpose units have low efficiency and a large specific weight per unit of output. They can produce as much as 10,000,000 volts but only a few hundred microamperes; this limits output of most to a few hundred milliwatts. The voltage generated depends on the insulating characteristic of the surrounding materials. The generators are relatively expensive. Hopes have been expressed that they can produce higher outputs, but some have been retired.

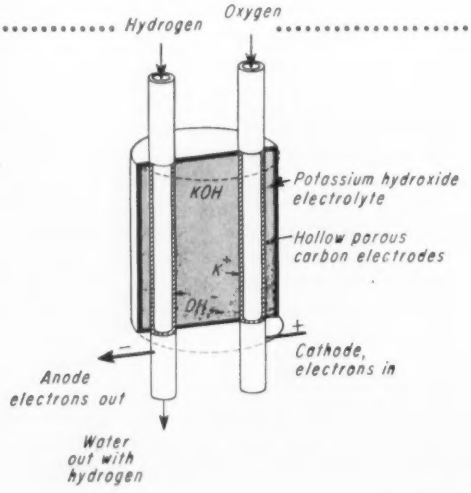
Target for tomorrow–change heat directly



ELECTROKINETIC energy may be produced by a fluid flowing past a solid surface. This effect is most marked when the fluid passes through a porous solid such as sintered glass. When the fluid flow takes place as sonic pulses, voltages as high as six volts may be produced but currents are only on the order of 1/100,000 amp and efficiency runs at about 1/10,000%. While a device such as a porous-solid pickup may be useful for measuring the flow of liquids in a pipeline it does not appear promising as a method of generating electrical energy from mechanical work. Diagram at left shows an experimental setup to measure performance of a fritted disc in generating ac from flow in the form of pressure pulses.

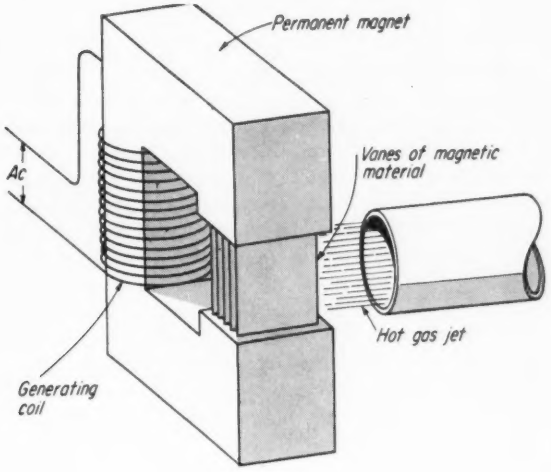


ION-PERMEABLE MEMBRANE batteries convert chemical energy to electrical. Their membranes are highly resistant to some concentrated acids, bases, salts and most common organic solvents. Openings through the membranes allow ions to pass by displacing some of the ions lining the passages. The membranes consist of synthetic ion-exchange resins with a high internal concentration of ions, such as potassium or chloride. The batteries have cells of alternate dilute and concentrated electrolyte solutions, divided by alternate anion and cation membranes. Batteries of ten cells using KCl solution develop on the order of 0.1 volt at open circuit. At present, cells can generate only a few microwatts with a few hours' life.

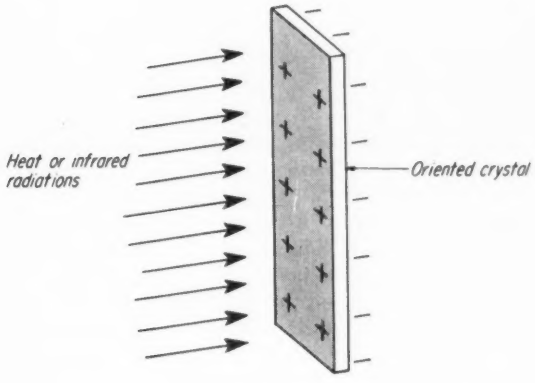


FUEL CELLS convert the chemical energy of fuels directly to electrical energy. Still in the laboratory, these cells can run more efficiently than power-plant cycles. The cells contain an electrolyte and two porous electrodes, through which the gases flow. Cells could use solid fuels but one successful type passes hydrogen through the anode and oxygen through the cathode. Chemical reaction between the hydrogen and electrolyte at the anode releases electrons that can be made to flow through an external circuit and re-enter the cell at the cathode. Reaction of the oxygen with the electrolyte at the cathode absorbs the electrons. The electrolyte remains unchanged in the ideal case with a continuous feed of gaseous fuel.

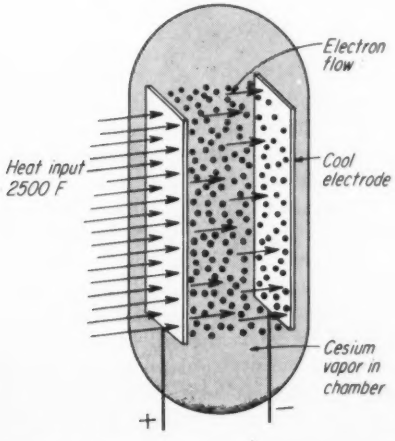
to electrical energy at better efficiency



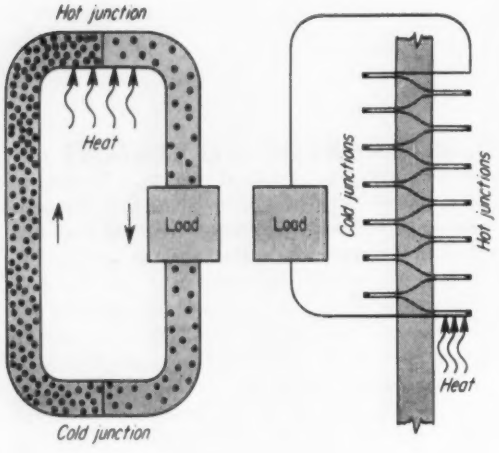
THERMOMAGNETIC GENERATORS convert heat energy to electrical energy. Heating a magnetic material decreases its magnetic field strength; allowing it to cool will re-establish the field intensity. A coil wound around the material as in sketch, left, would have a voltage induced in it as the field strength waned during heating of the vanes in the magnetic circuit and as the strength grew during cooling. The hot-gas flow would be controlled by a valve. The current frequency is limited to a few cycles per second. No data is available on overall efficiency. Heating can also vary width of an air gap to change field strength. This generator can use waste heat from power and process cycles as a cheap source.



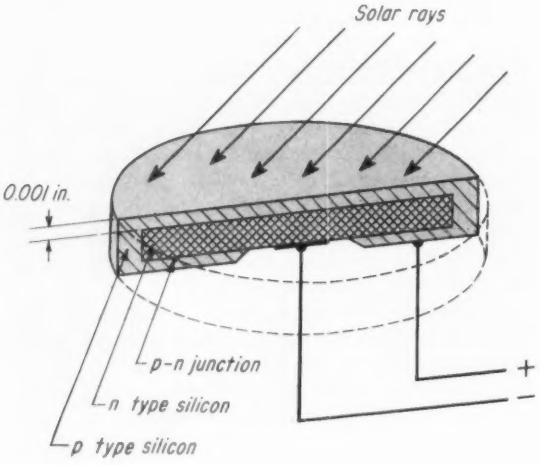
PYROELECTRICITY is generated in certain crystals by heating, or exposing them to infrared radiations. Heating one face of a crystal generates a voltage between that face and the opposite one. Properly oriented crystals of tourmaline and tartaric acid can detect temperature variations on the order of millionths of a degree. This method generates currents on the order of five billionths of an ampere; the crystals can follow variations up to 1000 cycles per second. Experimenters have trouble differentiating between electricity generated by the pyroelectric effect and that generated by crystal deformation and impurities. This electric effect has no importance as a power source now because of very low voltages.



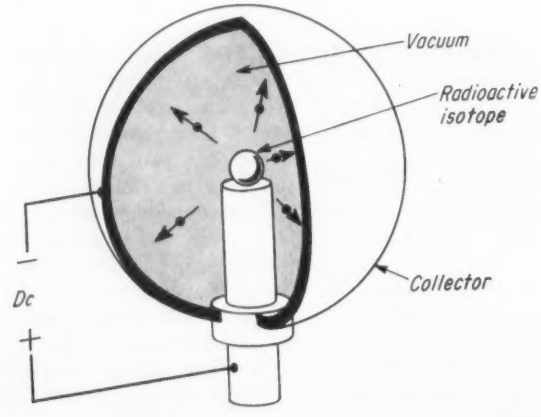
THERMIONIC EMISSION converts heat to electrical energy. Electrons can be driven off the surface of certain metals by heating them; the number ejected depends on the absolute temperature and the particular metal. This method uses two metal electrodes with different emission rates, in a cesium-vapor-filled chamber. Heating the higher-emission-rate electrode and letting the other stay cool makes a stream of electrons flow to the cooler one. The electrons then travel through an external circuit from the cold to the hot electrode, to do work. The cesium vapor partly ionizes and offsets the electron space charge in the chamber. Another unit has a high vacuum between closely spaced electrodes. Present units are small.



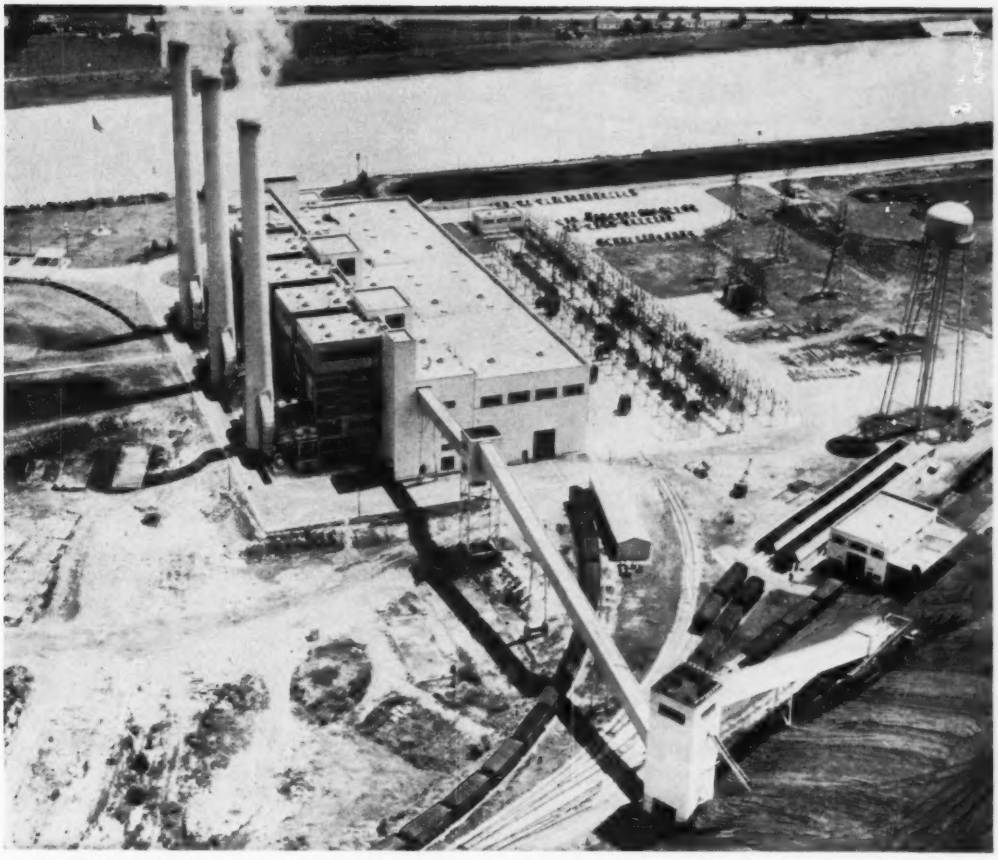
THERMOCOUPLES also convert heat to electrical energy. This effect, known for over 100 years, has been used to measure temperatures. Keeping one junction of two dissimilar metals hot and the other cold produces a voltage that sends an electric current through a closed circuit. These metals must have high electrical conductivity and low thermal conductivity to be efficient power generators. Low efficiency has retarded development of this method of power generation. Recent development of semi-conductors, mixed-valence metal compounds and plasmas for thermocouples has raised efficiency as high as 10%. Researchers predict that they will be able to raise efficiencies as high as 30%; good for standby plants.



SOLAR BATTERIES convert solar radiations to electrical energy. They use semiconducting silicon crystals that can be given different electrical properties by injecting certain impurities; *n*-type silicon has mobile electrons balanced by fixed positive "holes" while *p*-type silicon has a deficiency of electrons and mobile positive holes. A single crystal containing both types has a *p-n* junction, sketch left. The uneven distribution of electrons across the junction creates an electric field. Photons striking either crystal type eject electrons from their positions, which move under the force of the field. By connecting both sides to an external circuit, a working current can be made to flow, large enough to charge standard storage batteries.



NUCLEAR ENERGY can be converted to electrical energy since the reactions are bound to involve the electrons. Placing insulated collectors in a reactor core makes it possible to draw a small current at several thousand volts; but the electrical energy is only a small percentage of the total released in the reactor. The reactor heat could be used to activate a thermocouple, efficiency depending on the thermocouple. Radioactive isotopes emitting alpha, beta and gamma rays can be used to generate electric potentials between electrodes and generate a small current. The output usually runs in the order of microwatts and the life of the unit depends on the half-life of the radioactive isotope, which varies from a few hours to many years.



ULTRAMODERN Dayton P&L's O H Hutchings station went from ground-breaking to on-the-line in 19 months

Ash handling: a modern approach

- Designed on unit principle, utility's generating units were to be entirely independent of each other. Plans called for adding 60,000 kw each year for six years
- Initial bottom and flyash-handling system had to be in keeping with station's overall theme of centralized control, yet easily modified as new units were added

An ultramodern generating station, incorporating all the advantages of scientific development in the power industry, had long been the dream of O H Hutchings, the Dayton Power & Light Co's vice-president. But big coal-burning power plants produce astronomical quantities of ash, and ash handling was, historically, an unpleasant, labor-consuming, costly phase of power-plant operation. This was a challenge, and how DP&L met it to get maximum efficiency at minimum cost is a case study of modern ash handling.

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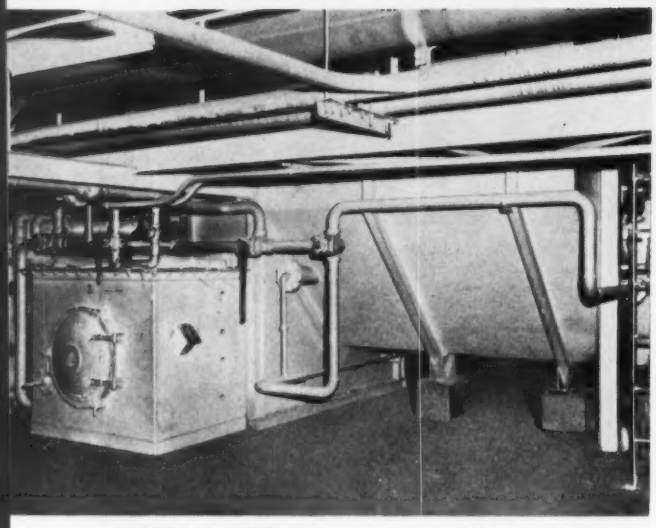
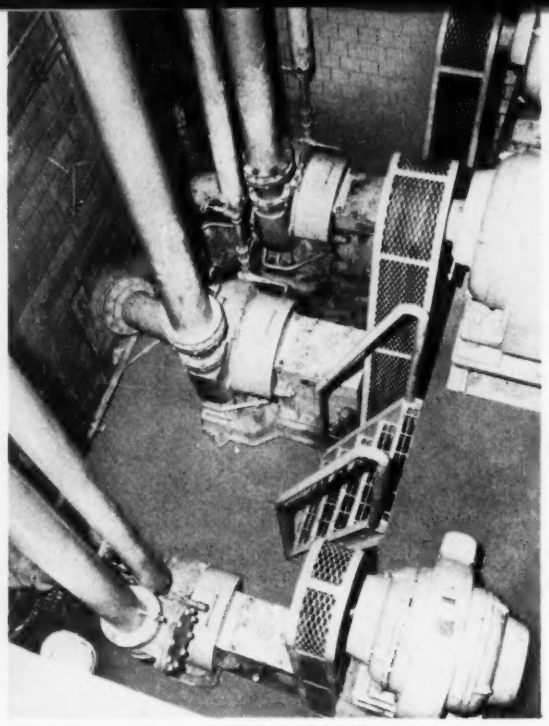


SIDE-OUTLET HOPPER stores bottom ash between sluicing periods. Sluiceway is in front; ash gate, feed housing at left



ASH PUMPS move ash and water from sump (behind wall at left) to fill area. Pumps' location in pit eliminates priming

Original ash-removal system was modified with little difficulty to cope with pyrites and reheat-section problems

Fabled Paul Bunyan's exploits held us spellbound as children, and we would have stared in disbelief at anyone who dared suggest that a mere man could ever perform feats on a par with Paul's. But at Dayton Power and Light's O H Hutchings station it's being done. Here, one man moves almost 200 tons of ash from the power plant each day, with little more than a wave of his hand. The man doesn't have a superhumanly strong back, nor does DP&L own a single blue ox. But they do have the magic of modern ash-handling equipment which, with its tireless muscles directed automatically by a central control board, is a far cry from the labor-consuming way ash was removed a few short years ago. And the system's clean, efficient and economical performance today is due to far-thinking planning when ground was first broken for Hutchings station just after the close of World War II. To put the situation in proper perspective, let's start at the beginning.

Electrical-energy demand in Greater Dayton and Ohio's Miami Valley area was outstripping the DP&L system capacity in 1946, despite periodic increases in capacity during preceding years. Even though the capacity of Miller's Ford station (now the Frank M Tait station) was being upped to 210,000 kw, it wasn't going to make enough of a dent in the new demand. This was obvious as signs of an industrial boom became more and more evident in the area.

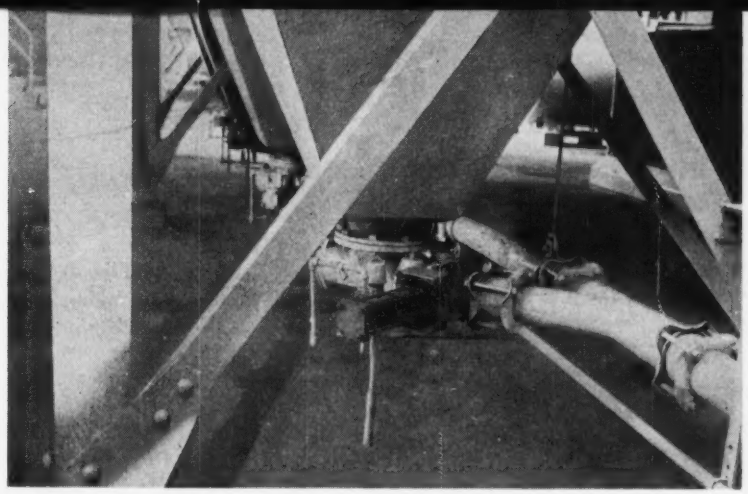
So Hutchings station was born. It was laid out on the unit principle, with each of the proposed six units completely independent of the others. Construction schedules called for adding a 60,000-kw unit each year for the following six years.

Steam generators for the first two units each produced a half-million lb steam per hr at 1350 psi, 950 F. Big boilers have big furnaces, and these were no exception, each having a gross volume of 34,000 cu ft. Burning pulverized coal, they would produce a lot of bottom ash which, along with many tons of flyash caught each day in the dust-collection system, would have to be removed and transported to nearby areas needing fill.

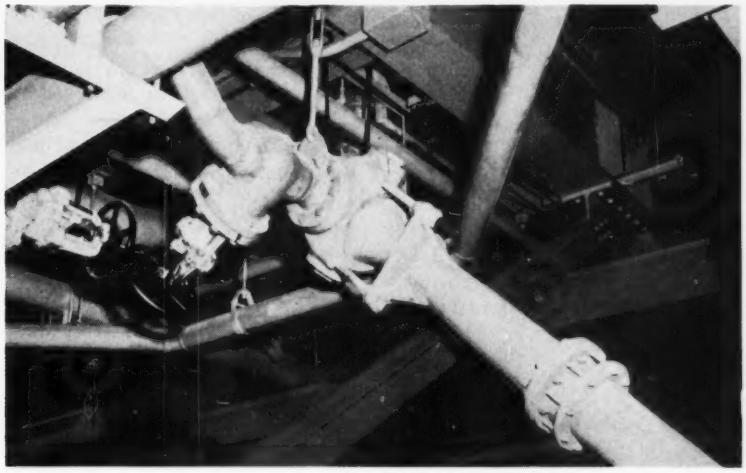
Experience with pneumatic ash handling had convinced DP&L that wet handling of both bottom and flyash would be more efficient for the new station. Original plan called for a hydraulic system to serve the six proposed units, but to be installed in three groups as the units were put on the line. Contract for the ash-handling equipment for units 1 and 2 was awarded to the Allen-Sherman-Hoff Co, who set up the original system as follows:

Bottom ash from the two units is collected and stored between sluicing periods in lined, insulated, steel side-outlet hoppers. Expansion of the dry, basket-type-bottom furnaces is taken care of by a water-sealed joint between furnace and ash-hopper walls. A pool of cool water in the hoppers quenches clinkers and slag dropping from the furnace. Thermal shock disintegrates the large chunks or makes them brittle. Cooling water from the i-d fan hydraulic coupling oil cooler maintains the quenching pool.

Piston-operated vertical-lift gates



AIR-ELECTRIC materials-handling valves at dust-collector bottoms regulate flyash discharge into 4-in. conveyor pipelines. Central cubicle controls all hopper discharge



HYDROVACTOR produces vacuum for flyash-conveying lines from units 1, 2 and 3. Duplicate serves units 4, 5, 6. They mix flyash, water; discharge 150 tons per day

pass ash from hoppers to stepped-concrete nickel-iron-lined sluiceways. Water jets at gates and feed plate heads help to wash ash from hoppers. Two 1500-gpm 365-ft-tdh pumps (one held as spare) supply river water to the jet nozzles.

Sluiceway discharges ash and water to pump sump. As originally installed, two 1100-gpm centrifugal ash pumps moved the ash about 300 ft through 6-in. pipe to the fill area. Both pumps were V-belt driven by 75-hp motors. One pump handled the load, one was a spare. When the station added more boilers, and initial disposal areas were filled, pumps were speeded up to deliver 2200 gpm and piping system modified to provide some 1200 feet of 8-in. disposal lines.

Pump-sump makeup-water supply is from the pump supplying the jet nozzles. A float-controlled valve and overflow weir hold water level constant in the sump. Excess water overflows from ash sump to a bilge and is pumped to waste by a float-controlled, 20-hp motor-driven belt bilge pump.

Flyash disposal. Flyash is collected at eight points on each of units 1 and 2 and from their common stack. Six air-electric valves pass flyash from hoppers beneath each 2-stage, split, interbank pendant type superheater; two similar valves are located below each of the centrifugal type dust collectors. A Windswept dust pan is located in the stack.

Flyash is conveyed pneumatically through a 4-in. pipe system. System's vacuum is produced by a Hydrovactor—a jet pump which mixes flyash with water and discharges mixture to the bottom-ash sluiceway. Segregating valves isolate vacuum-line sections to confine vacuum to working areas, increasing handling rate. A sequence-control cubicle automatically regulates discharge at all collection points except the stack.

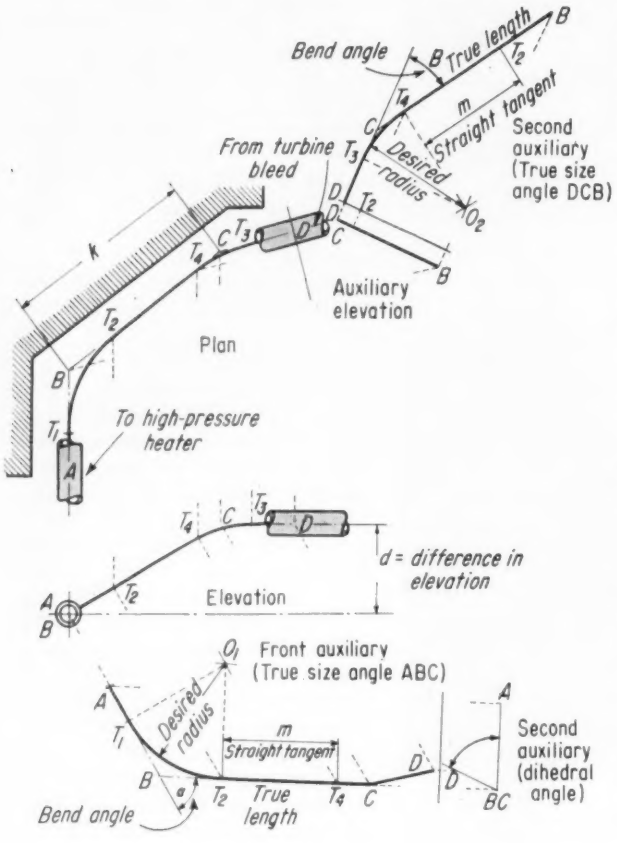
Next, units 3 and 4 went on the line. They each were 430,000 lb per hr capacity at 1500 psi, 1000 F/1000 F. (Units 1 and 2 had no reheat sections.) Sluiceway system was merely extended by Allen-Sherman-Hoff to serve the two new bottom-ash hoppers. Major difference was including pyrites handling with the bottom ash. Previously, pyrites had been collected in wheelbarrows and dumped into the sluiceway. A new auxiliary sluiceway now replaced the wheelbarrows.

Reheat section presented a slightly different flyash problem. Four hoppers were put under the dust collectors instead of two; collection from the superheater was not necessary. New conveying lines, equipped with segregating valves, were connected to existing system and operated under the same vacuum-producer. The new stack's Windswept dust pan was tied into the existing system and the automatic sequence-control cubicle was modified to control new units.

Finally, units 5 and 6 (identical with 3 and 4) went into service. Again, bottom-ash and pyrites were handled simply by extending existing sluiceways. Flyash handling, however, meant some changes. A second conveying system was installed for units 5 and 6, and collection from unit 4 was tied into the new system. Collection points and equipment for units 5 and 6 were identical with those of units 3 and 4. A new automatic sequence control was installed for units 4, 5 and 6.

In the ten years since unit 1 went on the line, the entire ash-handling system has justified DP&L's planning. Not only is the system itself operating efficiently with a minimum of maintenance, but, with further accent on economy, it ejects 182 tons of ash a day at its lone operator's bidding.

Solution 1: Fabricated bends in continuous piping



Solution 1 employs continuous pipe with two bends. Detailer must show bend location and radius, tangent points and necessary angle of bends, dihedral angle between planes of the two bends, also the true lengths and gradient of the straight tangent section between the bends.

Section *BC* in plan view may be set wherever desired. Elevation view shows angle *ABC* as an edge. A front auxiliary view taken adjacent to the edge view gives true size of angle *ABC*. Assuming a convenient bend radius as five pipe diameters, center of the bend arc is at O_1. Tangent points T_1, T_2 are ends of perpendiculars from O_1. Project T_1, T_2 in plan and elevation views.

Construct auxiliary elevation view for bend at *C* so *CD* shows as a point and angle *BCD* as an edge. A second auxiliary adjacent to edge view represents true size of bend angle *BCD*. Center of arc O_2 is five diameters from *BC* and *CD*. Perpendiculars from O_2 locate the tangent points T_3 and T_4.

Straight tangent between T_2 and T_4 is true length *m* in either true size auxiliary view. Slope for the *BC* portion, or T_2-T_4, is the rise *d* divided by horizontal projection *k*.

The angle that must be used between the planes of the bends, *ABC* and *BCD*, is constructed in lower right corner, at left. This is the second auxiliary view adjacent to front auxiliary, in position to show common line *BC* as a point. After you find points *A* and *D* from true dimensions in the front auxiliary and second auxiliary elevation views, the dihedral angle between the two planes is *ABCD*.

Design your piping layout to take

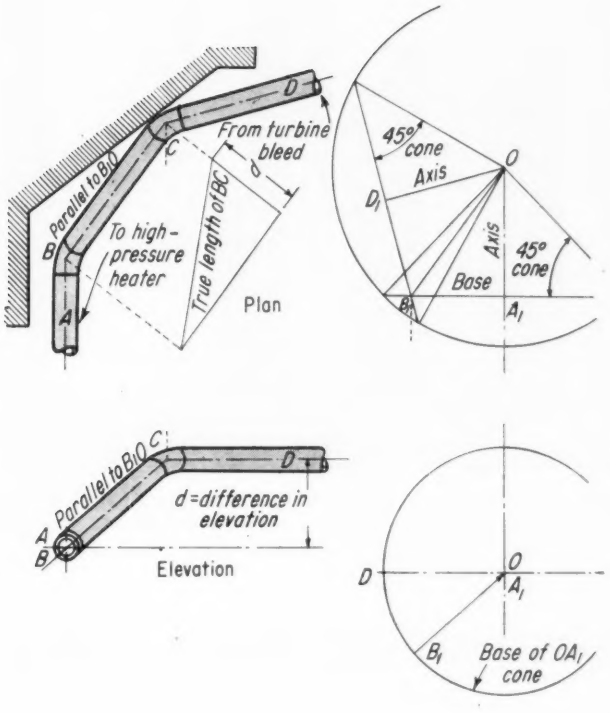
Power plant piping can be an engineering nightmare of complicated bends, grades and loops, but if designed properly, may mean big savings in construction and operating costs. These sample drawings can help you design a better layout for your next piping job

By PHILIP O POTTS, Associate Professor of Engineering Drawing, University of Michigan

Piping for water, steam, oil and gas service turned in recent years to pipe bends and welded joints, rather than the older type of flanged joints and cast fittings. This is especially true in high-pressure lines of steam power plant installations. With up-to-date fabrication facilities, piping vendors have no difficulty in supplying whatever shape and type of pipe connections may be most desirable in economy of material and space, and in ease of installation.

However, piping detailers must be aware of what the best possibilities are, physically, and be informed on

Solution 2: Standard weld fittings and straight pipe



Solution 2 connects this same piping by two 45-deg direction changes, using standard 45-deg weld fittings (as at left). However, position and location of central portion *BC* cannot be assumed or put wherever preferred. It must make a 45-deg true-size angle with both *AB* and *CD*. Its location can only be found by proper geometric constructions, based on finding the intersection line of two locus cones.

Draw two intersecting lines, OA_1 and OD_1, respectively parallel to the pipe segments *BA* and *CD* in plan and elevation, through any point *O* as vertex. Construct two locus cones, on OA_1 and OD_1 as respective axes, with 45-deg angle between sides and axes (the tube-bend angle). Their bases intersect at B_1 (Two locations for B_1 are possible, the one shown meets problem requirements). The line from B_1 to *O* is an element of both cones, therefore it makes a 45-deg angle with both OA_1 and OD_1.

Any line parallel to B_1O will, if it intersects pipe segments *AB* and *CD*, make a 45-deg angle with those segments. In the elevation view, where *AB* shows as a point, draw a line from *AB* parallel to B_1O intersecting *CD* at point *C*. Locate point *C* in plan view by alignment, and draw line *CB* backwards parallel to B_1O until it intersects *AB* at point *B*. Thus *BC* is fixed in both views.

The slope and true length of *BC* is found by special construction alongside plan view. Necessary length of straight pipe between 45-deg tube fittings is *BC* minus twice the center-to-end distance of the fittings, as specified in the fittings catalog.

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advantage of welded fittings or bends

ways for determining and representing the details on drawings.

The piping layouts, above, although harder to detail than flanged pipe, cut friction loss and material cost.

Problem. High-pressure steam line runs from turbine bleed to high-pressure heater. Horizontal portion of line must change direction and elevation, clear structural interference at the same time. In drawings, portion of the line from turbine is *DC*. Turbine bleed line must connect, through necessary turns and with minimum resistance, to portion of heater line *BA* at level lower than *DC*.

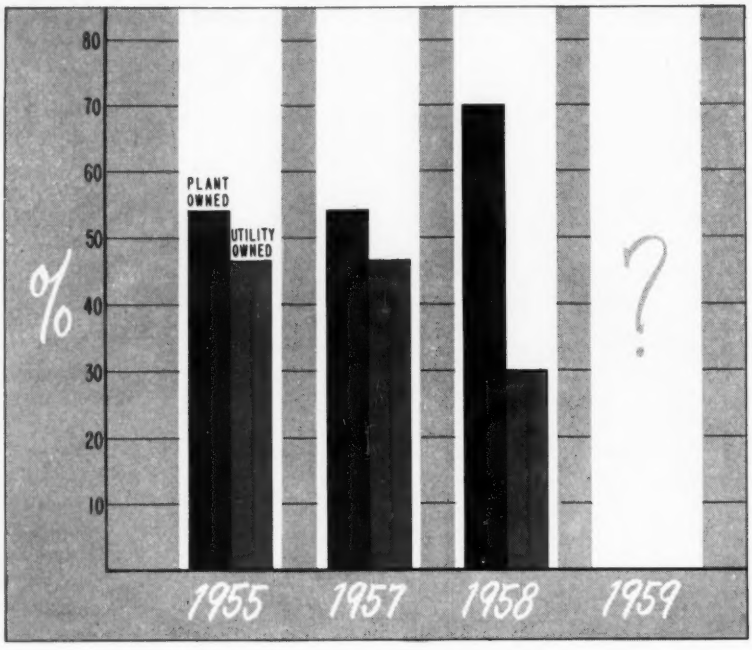
Solution 1 starts with respective elevation views where two outside portions of piping, *AB* and *CD*, project as point-views. This can be done since *AB* and *CD* are horizontal and true-length in plan view. This would be the starting situation in at least 90% of piping layouts. However, for any two "skew" lines in any direction or position, a draftsman can set up desired projections, of which one shows one line as point-view and the other shows both lines in true length. Either solution then proceeds from these two views.

Solution 2 involves "standard" elements, but care must be exercised when fabricating or welding the tube bends to the central portion. The direction or angularity of the bends must be carefully controlled to insure outside portions *AB* and *CD* come out horizontal and in the position given in the drawing. Dihedral angle between planes of the two bends may be found by second auxiliary view described in the bent-pipe solution. No solution is possible with 45-deg turns if the angle between *AB* and *CD* in the plan view is 90 deg. However, in that case use of 60-deg turns would permit a solution.

Power to grow ...electrically

No. 17: PRIMARY-SUB OWNERSHIP

POWER's PTG program was launched in the Sept 1956 issue with the following statement: *Growth is today's biggest industrial fact. Gearing up for it rates No. 1 priority for power-service men, top management. This means a 2-part job for you: (1) planning power to grow into the electrical system on which production depends, and (2) convincing top management that a small investment now for expansion flexibility will pay off in the years ahead.* It still holds true.



SUBSTATION OWNERSHIP survey data, plotted above, showed a statistical spurt last year. Plants indicating part-ownership of primary substations were not tabulated

Will self-ownership of primary subs

- We believe so. One indicator is the result of our limited survey charted above
- Decision often hinges on whether the added capital investment can be justified
- In general, it's the larger plants that benefit most from self-ownership

Complete ownership, operation, maintenance of the primary sub is a logical step for some industrial plant engineers to take. But with the rate advantage and fringe benefits go engineering responsibilities of equipment selection, location, detailed station design and maintenance.

If the interest we detect in primary-sub ownership grows, you may be facing some new considerations on your next electrical expansion or new plant planning. Here are some factors to keep in mind.

Owning your primary sub gives you more latitude in planning for growth; more control over your PTG index. It gives you a somewhat freer hand in determining sub location. Take the Superior Tube Co in Collegeville, Pa. as a case-in-point (POWER, Oct 1958, p 98). Here the normally outdoor sub was brought inside the plant, mighty close to the true load center. Their new 1500-kva sub, transforming 33 kv to 480 v, is smack in the center building wing, making it easier to expand in several directions. The 33-kv comes into the plant over pole lines from utility sub, with fused disconnect on the pole at start of the run.

Split ownership of a plant sub is quite common. Here the utility owns the disconnecting equipment on plant end of feeder, power transformer and necessary metering. Industrial takes switchgear as fed from transformer secondary. Transformation at the master sub is often sidestepped where utility supply voltage is below the 15-kv ceiling set by NEC for most installations. But it may be in order even then if big motors or other loads operate best at some voltage other than the utility's.

Three features stand out in the design of primary subs: *location, reliability, protection.* Here's some thinking on each:

Location, if ideal, would be right in the plant load center. But sheer practicality and utility requirements usually put it at the edge of the plant property. And modern equipment enclosures make outdoor building-less installation the rule rather than exception. Added cost of outdoor gear

Learn the facts on rates and plant loading

One logical starting point in analyzing the economics of high-voltage primary substation ownership is your electric power bill. Dig into its makeup for a better understanding of demand, energy, load factor, pf, off-peak buying, fuel clauses, discounts.

Total costs in any electrical bill split into two broad classifications: *fixed charges* and *variable charges*. Fixed charges cover all generally predictable costs such as depreciation, interest and insurance, on capital investments. In the latter group we have land and equipment. Once the capital investment is made in a primary substation and a definite depreciation time set, the charges hold somewhat constant over the period. Study any utility rate schedule and you will quickly spot these two characteristic parts. Fixed charges are generally covered by the demand charge. The variable charges come under the energy charge section.

Load factor is another important item. A plant working an 8-hr day with a steady 1000-kw load, ties up as much generating transmitting, distributing equipment as a plant operating around the clock at the same kw load.

Rate schedules suggested by the utility take a host of factors into consideration (POWER, April 1954, p 75). For instance, small users who are supplied in the 120/208- or 480-volt range are generally serviced through utility-owned transformers and switching equipment. But when load warrants moving into, say 4160, 13,800 v or higher, the plant may want to buy and install the primary-sub gear, receiving in turn a rate discount to cover its own fixed charges. Larger plants find ownership appealing.

by industrials continue to grow?

must be balanced against building costs. Some engineers strive for outdoor location of utility switching and transformers when above 15 kv, placing plant primary switchgear indoors. Where corrosive fumes, residues, may settle on h-v insulators, study indoor design. Or at least place sub on windward side of source.

System reliability—your system—can't exceed that of utility supply. So check its adequacy. Ask utility for outage expectancy based on past experience in your area. Underground cable generally fares better than overhead, but faults often take longer to find and fix.

Protection starts by pinning down available short-circuit kva (POWER, June 1958, p 73). Check if projected utility interconnections will increase this value. Many utilities are predicting an ultimate available short-circuit current which they say will not be exceeded within a given period, say 20 years. The industrial designs accordingly. Should available amps exceed predicted value, the utility takes responsibility for either supplying reactors or changing switchgear.

Packaged-unit subs usually prove a better bet than field-erected units. Equipment cost may run higher but with proper planning installed costs are lower and you wind up with a smart, well-coordinated unit. These unit subs are made up of one or more transformers mechanically and electrically coordinated with one or more switchgear assemblies. Incoming section provides for the h-v circuits which may or may not have individual breakers. Transformers are usually oil filled. Outgoing section handles plant primary feeders.

However, plant expansion into full primary-sub ownership involves the power transformer more than the switchgear; specifying the switchgear is generally the industrial plant's responsibility anyway.

Transformers, although oil filled, present a minimum fire hazard when properly applied and maintained. Yet the fire angle must be considered. Hazard can be minimized by setting transformer on a concrete base with curbing at least 6-in. high around the edge. Design the base to extend at least 3 ft beyond the transformer in all directions. Fill basin thus formed with coarse crushed stone. Be sure to provide a drain.

Protect important oil-insulated transformers with fixed fire-extinguishing systems, either manually or automatically operated. You be the judge of how important your primary-sub transformers are.

PTG angle comes in determining transformer size, providing space for additional units, considering beforehand how to handle sudden emergency loads. Recall that heat affects life of winding insulation and oil. Fans blowing on tanks and tubes drop oil temperatures, allow up to 30% load rise. Fans brush off air film clinging to the surface of radiators and improve heat transfer. In an emergency, if fast temporary cooling is needed, plan to spray water on tank and tubes. Almost any self-cooled transformer can have its out-

put increased about 67% by effective use of the water-spray technique.

Single-phase vs 3-phase transformer question is now pretty well settled. Reliability of today's units makes the single 3-phase transformer the more logical and economic choice. Some engineers still feel there are cases in large substations where three single-phase transformers are the better choice. They compare availability problem when replacing a large 3-phase unit against continuing operation with two singles open-delta.

Primary voltage is another matter linked to the transformer picture. Keep in mind that each commonly used primary distribution voltage—2.4, 4.1, 13.2 kv—has its place. Yet many power men still use the old rule of thumb: 4.1 kv for plants having a supply transformer or generating capacity or both of 10,000 kva or less, and 13.2 kv where there is a supply transformer or generating capacity or both of 20,000 kva or more. This, like any rule of thumb, must be seasoned with caution. And caution starts with an engineering analysis after checking available voltage levels with the supplying utility. In choosing any voltage keep in mind your plant will probably grow (POWER, Sept 1956, p 75).

For overhead structures look into use of aluminum, especially where corrosive atmospheres may cut through galvanized steel. When steel's coating is gone, painting must start. This usually calls for killing all or part of a substation, and becomes another maintenance headache. In a few industries, aluminum may not stand up. Some chemical and petroleum plants have reported trouble.

Who should own a primary sub? There's no universal answer. Where a choice is offered, the many pros and cons can only be settled by an economic study. Rates are more favorable when the user owns a sub, but initial cost and maintenance must be considered. Many large automotive plants set out, where possible, to buy at utilization voltage—usually 13.2 kv. Other industrials angle for ownership because they want greater control over operating reliability. Remember, if you own you need manpower versed in high voltage.

High setting on breaker trip leads to motor control burnout

A few hours after a spanking-new motor control center was placed in operation, two of the four vertical sections were destroyed. How? A series of explosive flashovers followed by heavy arcing. This centralized 440-v motor control center had all the latest features of dependability, durability and longevity built in. As reported by the Mutual Boiler and Machinery Insurance Co, all circuit breakers were in the off position.

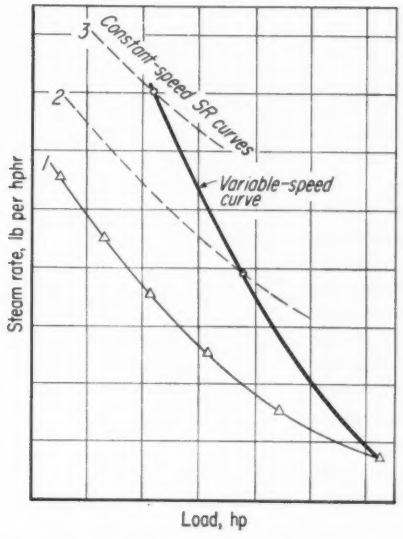
The 600-amp bus within the control was spaced on 5-in. centers, for a fault level rating of 25,000 amp. Bus insulators were of high-dielectric high-impact molded-material type designed with high-creepage paths; all of which was to insure positive electrical protection and support.

As usual with this type of accident, it's tough to find the exact cause since most evidence is destroyed by arcing. Two possible grounding points were spotted which may have caused the phase-to-phase high-resistance fault triggering the destructive forces. A lead on the pull-out breaker-starter assembly, running from stab connection to breaker, was found pinched and fused to the frame. Second possibility was a ground found on one of the three 500-mcm cables feeding the control center. An overheated lead might have burned off to start fault-current flowing.

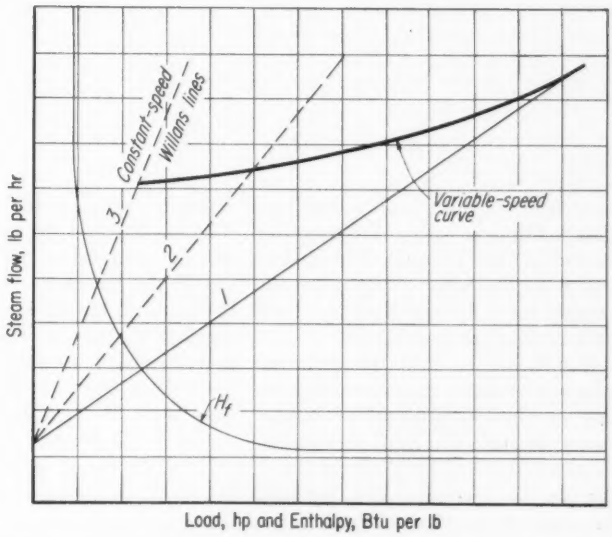
Power supply to the control center was from a newly installed 1000-kva unit sub through a 600-amp air breaker that had a dual adjustable instantaneous and time-current trip. But the breaker didn't function to prevent the burnout. Fault had burned itself clear by the time breaker was manually tripped at the unit sub.

Trip device had a time-delay pickup setting of 100% or 600 amp and an instantaneous setting of 15 times this value. So the instantaneous trip should have cleared a 9000-amp fault in about 0.04 sec. The nonoperating instantaneous trip kept the circuit breaker from doing its job.

Breaker was furnished by manufacturer with an adjustable instantaneous trip having a range from 9 to 15 times breaker rating. And the maker recommends this range to prevent false tripping during motor starting. The breaker was shipped from the factory with the instantaneous trip set at 15 times rating. But the trip should have been reset as low as possible after the breaker was installed. Had time been taken to reset to 9 times rating or 5400 amp, the insurance people figure the breaker would have operated in time to prevent destruction of the motor control center.



1 From the family of constant-speed steam-rate curves we can easily plot the steam rate for shaft output at varying shaft speeds



2 From Willans curves for constant-speed operation we can plot the flow curve for shaft speed varying with the shaft-horsepower output. H_f curve shows the enthalpy of exhaust steam for one speed

Although mechanical-drive turbines are relatively simple machines, they prove to be versatile over a wide range of operating conditions. But to apply them correctly we must know . . .

How to plot m-d turbine performance

By A H SISSON, Manager, Thermodynamic Design, Small Steam Turbine Dept, General Electric Co

The most useful way to give m-d turbine performance is in terms of the *steam rate*. This is the steam flow through the turbine in pounds of steam per hphr, at a definite hp shaft output, for given steam pressure and temperature at the throttle and a given exhaust pressure and shaft rpm.

Steam rate curve. Steam flow through a turbine varies almost directly with shaft output when controlled by a single valve and with turbine running at constant shaft speed. By calculating two points we can plot a straight *Willans line* as curve *1* in Fig. 2. Such a straight line lies very close to the actual performance and can be used for all heat-balance calculations when applying the turbine.

If the turbine must deliver shaft output at varying speeds we can determine its steam flow curve with the aid of a series of Willans lines, each for a different constant speed, as curves *1*, *2* and *3*, Fig. 2. Then if we know the speed needed for each given output we can find the variable-speed steam-flow curve, as shown, for the entire load range.

These Willans lines can be transformed into steam-rate curves as in Fig. 1. Each of the constant-speed curves corresponds to the flow curve of like number in Fig. 2. They all show the characteristic of most small turbines, decreasing steam rate with increasing load. Turbine usually runs most efficiently when fully loaded.

Valve control. When good efficiency is needed over the turbine load range, single valve control should not be chosen. In Fig. 3 the curve *1-2-4* shows the steam flow when a single valve controls all the first-stage nozzles. By grouping the nozzles into three sections we can shut off two of the sections by individual hand valves *A* and *B*. The main governor valve then opens with rising load to control steam flow along Willans line *8-7*. At *7* the governor valve is wide open; to

raise load we open hand valve *B* to pass additional steam through the second section of nozzles. This makes the governor valve throttle the increased total flow to hold the load at *5*, at constant shaft speed.

For increasing load the governor valve raises steam flow along Willans line *5-3*. Opening hand valve *A* passes steam through the third section of nozzles and makes the governor valve throttle the increased flow to hold the load at *2*. The governor valve opens again to raise load above *2* to the maximum at *1* along the upper Willans line. This arrangement gives unthrottled steam flow at *1*, *3* and *7*.

To gain better overall efficiency we use the sectionalized valve gear design that reduces the amount of throttling over the load range. This design has groups of nozzles controlled by independent, slightly "overlapping" valves. The valves open successively to bring the nozzle groups into wide-open nonthrottled flow automatically with increasing load.

Deviation of sectionalized valve performance from a true nonthrottled performance becomes smaller with an increase in the number of valves. We can't justify adding enough valves to eliminate throttling at *all* loads. In quoting performances of turbines using sectionalized valves, a smooth curved Willans line is drawn through the short curve sections to give an average trend.

Excessive throttling from any valve system will seriously lower turbine efficiency. In turbines with small available energy each 1% of throttling may cause more than 3% loss in energy. In turbines with large available energy this loss may be negligible. In small turbines the actual throttling losses represent the best economic compromise of thermodynamic and governor performance.

Horsepower vs speed. Another form of the curve of stage efficiency versus shaft speed can be given as hp output vs speed, as in Fig. 4. Curves *1*, *2*, *3* and *5* show how a turbine would behave for given constant steam-flow rates as the speed varies.

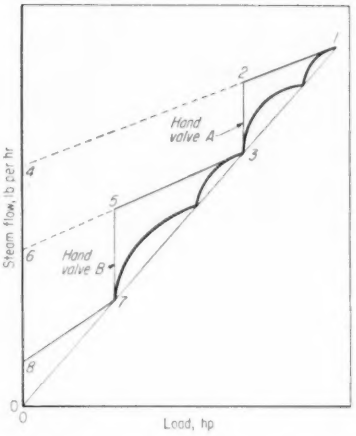
Curve *4* shows the hp required to drive a compressor over its range of speed; the hp varies as the cube of the speed. If the driving turbine were designed to carry a maximum steam flow of curve *1*, it could only develop the load at point *A*. If any attempt were made to drive the compressor at the 10% greater shaft speed of point *B*, the output would drop slightly and the compressor could not deliver a higher output.

To develop the higher output at the higher speed of *B* the turbine would have to be designed to pass the steam for curve *5*. The steam flow at *C* would have to be more than 1.1^3 times greater than the flow at *A*, about 35% larger, to develop the larger output at the higher speed.

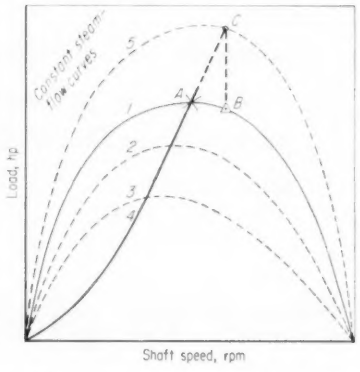
Efficiency. The "Theoretical Steam Rate Tables," by J H Keenan and F G Keyes, published by the ASME, give the steam rates at 100% turbine efficiency for a wide range of steam conditions. The steam rates are given in lb per kwhr, but can be converted to lb per hphr by multiplying by 0.746. To get actual steam rate we divide by the turbine overall efficiency; to get total flow multiply the steam rate by the hp output.

We usually do not quote single-stage turbine performance in terms of efficiency. But we often use efficiency for multistage turbines in the form of curves to obtain final quotation, usually in terms of steam rates. These curves usually give the rated load efficiency at some basic steam conditions, and are supplemented with various correction factors that adjust the efficiency to required steam conditions and speed.

Heat rate. M-d turbines seldom have their performance quoted as heat rates. They figure, however, into overall heat balances of installations and become important factors if there are a number of turbines. Boiler-feed pump turbines which are designed for extraction for feedwater heating play an important part in some modern central-station heat balances.



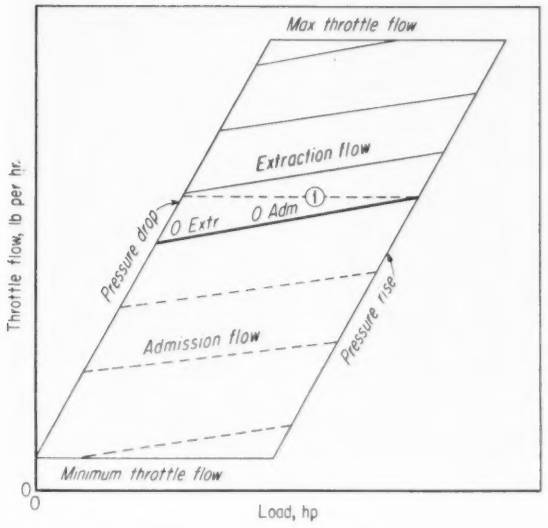
3 Adding valves to turbine control aids in improving performance at all loads



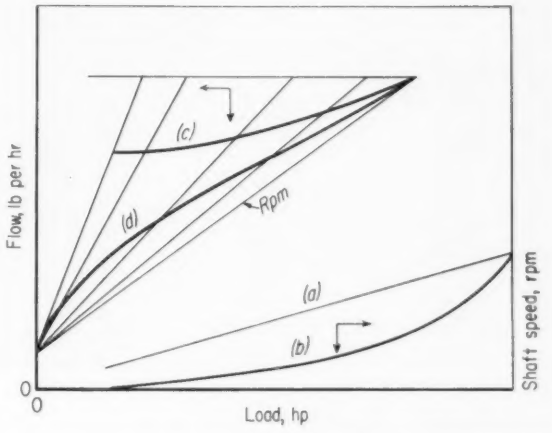
4 Constant steam flows produce varying outputs as shaft speed runs its range

Paper-machine drive. Turbines driving paper machines may be single or multistage. Sometimes they must run as slow as 0.1 of rated speed with load varying directly with speed; at other times load varies other than directly proportional to speed. In Fig. 6, curve *a* shows the hp-speed relation needed from a turbine, and curve *c* shows the steam flow vs hp of the turbine figured from the family of Willans lines for different turbine-shaft speeds.

Load vs rpm³. When turbines must drive a machine with steep



5 Turbines with extraction and admission openings must have a family of curves to define their performance over the range



6 Turbines with prescribed hp-rpm relations, *a* and *b*, have definite flow-hp curves figured from constant-speed flow curves

load-rpm relation like a compressor, fan or stoker their flow curves take a shape different than the one we just talked about. Figure 6, curve *b*, shows a load that rises with the cube of the speed. Curve *d* shows the corresponding flow-hp relation.

Extraction and admission. M-d turbines designed for steam extraction or admission or both usually have only one opening for steam withdrawal or admission. Figure 5 shows the typical family of curves that defines the performance of these turbines when running at constant shaft speed. For variable speed, families of speed will be plotted for each extraction and admission quantity.

In Fig. 5 the *maximum throttle flow* is predicted to pass through the first-stage nozzle of the turbine at contract conditions.

Turbine stages ahead of the admission stage must never have a flow less than the *minimum throttle flow*. At lower flow these stages might overheat badly and fail. The minimum flow may be assured by: (1) a blocked-open position of one of the valves (2) an orifice in the first valve to open, or (3) a bypass.

Pressure rise limit, set by the maximum effective area of the extraction stage, defines the maximum load at various extractions and admissions at which guaranteed extraction and admission pressures can be controlled. At greater loads, extraction and admission steam pressures rise; they may be high enough to blow the relief valve in the line.

Pressure drop limit, set by an orifice leakage area, defines the minimum loads at which there will be the required flow of "cooling steam" in the exhaust end of the turbine. This area controls the minimum load at which extraction and admission pressures can be maintained for the range of extraction and admission flows.

Limit line *1* shows maximum throttle flow for a turbine designed for admission only—not for both extraction and admission.

Expansion turbine. These gas turbines have their performance quoted as cubic feet per minute flow of gas at standard conditions of 14.7 psia and 60 F. Sometimes it may be quoted as either a gas rate or gas flow, similar to a steam turbine.

Exhaust enthalpy. For heat balance studies in applying an m-d steam turbine the enthalpy at exhaust must be known. This can be given as the curve H_t in Fig. 2. Each of the Willans lines in Fig. 2 would have its own enthalpy curve, since the enthalpy varies with the speed as well as the load on the turbine.

Enthalpy at exhaust is usually given as expected only; it's difficult to anticipate, among other things, the great variety of radiation and convection effects that some m-d turbines may meet in their application.

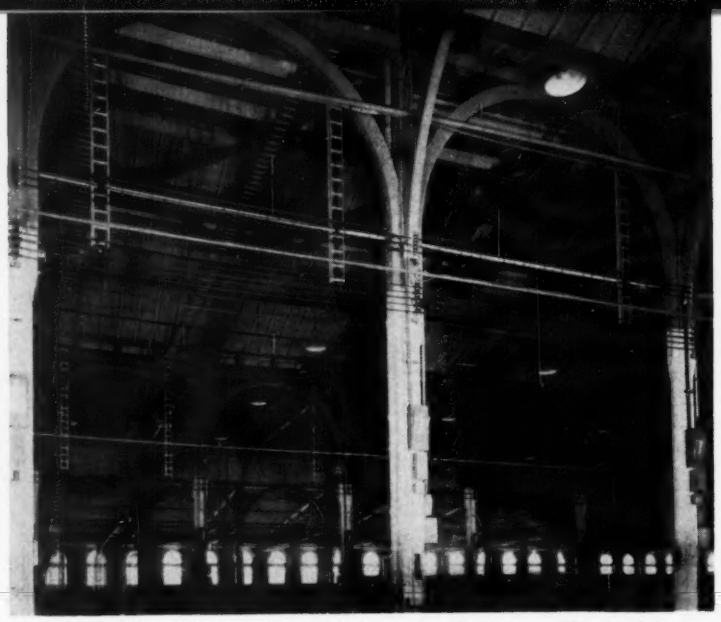
When needed, the enthalpy of the steam leaving at the extraction stage can also be given and expressed in curve form against steam flow.

Boiler-feed-pump drive. Turbines for this duty need the most detailed performance information. Ordinarily much cut-and-try calculation must be made to find a design that will perform the intended duty with best efficiency from an overall heat-balance standpoint in central stations.

This turbine application presents the most difficult problem in obtaining data from which to calculate overall performance. But, when removed from the heat-balance diagram and stripped of some of its extra governor controls, the turbine (especially the thermodynamic part) looks about as simple as the average m-d turbine.

Summary. These curves, Fig. 1 to 6, represent the major ways of presenting performance of m-d turbines at design steam conditions. Curves of correction factors may be supplied by the turbine builder to calculate performance at other than design conditions for a unit.

By WILLIAM WALLACE III
Ebasco Services



CABLE LADDER installed at Philadelphia Convention Hall keeps cable out of the way

You can save time and cut costs with cable troughs and ladders

Cable troughs and ladders are often used for the support of groups of power or control cables above ground at a considerable saving in installed cost over an equivalent conduit system. In addition to a lower cost, you may save time during installation and in the pulling of cables. A further advantage of open raceways is that cables are always accessible for inspection, maintenance and repair, and modification or expansion is a relatively simple matter. A disadvantage is that cables may be more subject to mechanical damage in troughs than in conduits.

To obtain the most desirable layout and achieve the maximum saving in cost for a trough or ladder system, give considerable attention to its arrangement during the early phases of plant design—while locations of mechanical features such as piping, valves and ventilating ducts are still flexible. The major decisions that you must make initially are: (1) location (2) size and (3) type of trough.

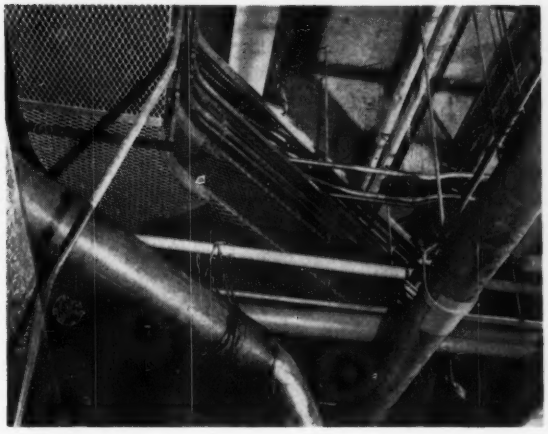
Location. What will be the location of the major trough run? The time to make this decision is early in the job, as soon as locations of major electrical equipment such as motors, switchgear, control boards and control centers have been fairly well established. Ideally, cable troughs should be installed in cool, dry locations, easily accessible for installation, but away from any source of possible mechanical damage. These areas are almost never obtainable around a power plant or industrial installation. The best compromise will be obtained, however, if early action is taken to reserve the space.

During the early stages of electrical design, you rarely know the details of actual control circuits or accurate sizes of equipment that determine the number and sizes of cables. Installations of similar size and type, however, can be utilized to obtain approximate cable sizes, number of conductors and termination points. With this information available, draw tentative cable runs on prints showing the layout of plant equipment and the areas that will be occupied by such items as major piping, ventilating ducts, etc. By combining cables of the same type (control low-voltage power or medium-voltage armored power) which follow approximately the same route on these drawings, desirable groupings for each particular trough system become apparent. It is generally possible to cover a given plant area adequately with a grid of troughs, the major parallel runs of which are 30 or more feet apart. It is not desirable to place control and power cables in the same trough.

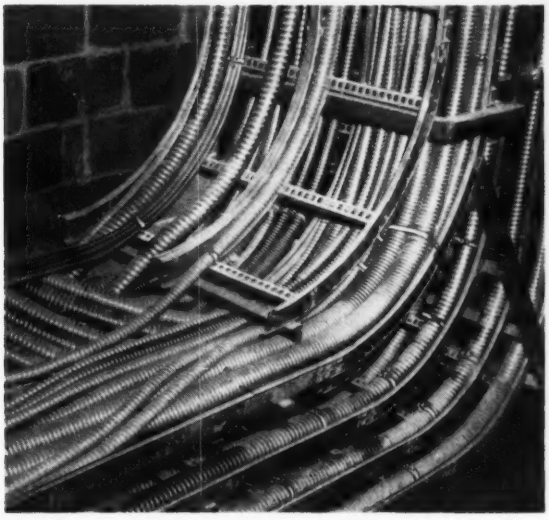
In laying out the trough system for control and the various power voltages involved on the particular project it is desirable, if possible, to provide a vertical or horizontal spacing between the different trough systems for access to the cables during installation and for maintenance. Such spacing also prevents the spread of fire should one result from a high-current fault in a power cable that is not cleared rapidly. When power and control troughs are stacked vertically, control troughs should occupy the bottommost position where they are least likely to be affected by faulted power cables. If power and control cables must be run in the same trough, sheet-metal separators should be installed to provide isolation between the two.

Sizes of trough. After establishing the general layout desired and the approximate number of cables in each grouping, you can determine the size of troughs. With control cables this is relatively simple since they

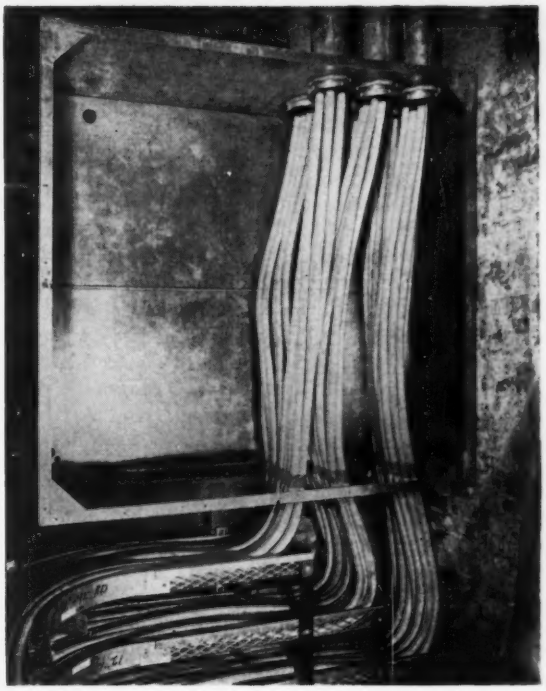
Growing list of devices and methods make installation and upkeep easy



AWKWARD SPACES between pipes and ceiling readily hold ladders and troughs. Barrier strips separate power and control



CLAMPS are a quick, inexpensive way to secure armored cable in a ladder-supporting system. Note easy crossover between ladders



CONNECTION with an existing conduit system is made through a box grounded to the trough. Transition requires minimum space

Current-rating correction factors

No. horizontal		1	2	3	4	5	6 & over
No. vertical	1	1.00	.93	.87	.84	.83	.82
	2	.89	.83	.77	.76	.75	.74
	3	.80	.76	.72	.70	.69	.68

carry little current and, therefore, can be installed to the full capacity of troughs in almost any configuration without giving consideration to derating of current capacity. From a practical standpoint, however, since this is a preliminary design it is wise not to occupy more than about 50% of the available trough area initially. This probably will increase as design progresses and more cables are added, but should be limited to a maximum of about 70% of the completed job. This leaves space for future additions. On this basis, considering a 1-in. diameter multiconductor control cable occupying a projected area of 1 sq in. as an average, an 18-in. trough with 3-in. sides should be provided initially for 27 cables, or a 24-in. trough for 36 cables.

Selection of troughs for power cables is a more involved matter, since they carry relatively high currents. Also, any grouping in close proximity will result in the derating of all cables from their optimum "in-air" current rating. Where large power cables are being considered and their current-carrying capacity is not limited by enclosures or high ambient at their terminations, it is usually more economical to use single conductor cables. Use one layer per trough and leave in excess of one cable-diameter spacing between adjacent cables. This permits using the full "in-air" rating of the cable. In this type of installation, however, and wherever single-conductor power cables are used, provide means of clamping the cable to the trough at frequent intervals to keep cables in the same relative positions and to prevent them from whipping in the event of short circuit.

For smaller power cables, use three conductor or triplexed cables. They

Cable troughs and ladders are gaining wide popularity with designers

can be installed more easily than single conductor, do not require clamping and are generally less expensive on an installed basis. They're generally arranged two layers to a tray with little space between adjacent cables. Under these conditions apply derating factors in table. These factors, which have been widely used for many years, are percentages of the "in-air" rating of a single- or 3-conductor cable.

Derating factors apply to banks of equally loaded cables having more than one-quarter but less than one diameter spacing between adjacent cables. As can be seen from the derating correction factor table, it is generally undesirable to use more than two layers of power cables in these troughs since derating becomes excessive. In the case of troughs where each cable is loaded differently—some to only a small percentage of their capacity—considerable engineering judgment must be used in sizing cables.

When you have prepared sketches showing the proposed layout of the major trough system, including number and size of troughs at each location, arrange a meeting with the other engineers concerned with the job. Your layout has already taken into consideration the major mechanical and structural features of the plant, but other engineers may be considering use of the space proposed for the troughs. This is especially true for mechanical facilities since these systems are developed concurrently with the electrical design. If the major trough layout sketches are reviewed early enough, the conflicting facilities may be relocated, or at least the best compromise may be obtained.

Cable troughs prove economical any time four or more cables follow the same general route. Therefore, many small troughs may be included in the final design. These are very flexible, however, and can be located as design progresses or on the job so as to dodge obstructions.

Types of trough. With the present wide use of cable troughs, the types available for any installation have increased greatly. The expanded-metal troughs which several years ago were almost the only type available are still the most widely used. A complete line of fittings to cope with every installation problem has been developed. One manufacturer has adopted connectors that join trough sections and fittings with only two pins at each joint. (See POWER, Nov 1957, pp 124-125.)

A more recent development is the ladder type rack which has parallel stringers made of structural members connected at specific intervals by rungs. It's available in several widths from 6 to 24 in.

Troughs were originally furnished with a painted finish. Repainting was an expensive job, especially when cables had to be removed and supported elsewhere during this operation. Galvanized iron or aluminum which require no maintenance under most conditions are now very common types of cable trough.

Troughs or racks selected for a particular installation should be the most economical that will support the cables properly. For large, relatively stiff power cables, a ladder-rack construction having the rungs spaced about 18 in. apart is available. This is the least expensive construction. The rungs provide an easy means of clamping cable to the rack. For control and small power cables which are rather flexible, these racks may cause festooning. This is not only unsightly but causes mechanical stress concentrations that may damage some types of cable. For such applications, use ladder racks with rungs spaced not more than 4 in. on centers, or use troughs—whichever is more economical in your particular case.

Galvanized steel racks and troughs are cheaper and satisfactory for most applications with no further finish. Where atmospheric conditions attack the galvanizing, aluminum often does the trick.

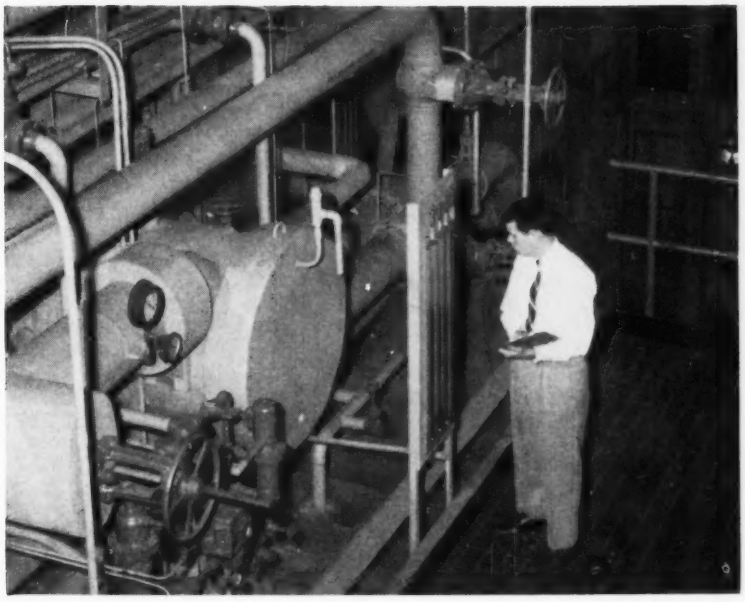
Solid covers should be specified for all trays under catwalks, near stairways or at other locations where weld spatters, cigarettes, tools or other small objects might be dropped into the troughs and damage cables. Where these troughs carry power cables, provide louvers for ventilation. Expanded metal covers are useful to keep cables in place in vertical runs.

Troughs and racks may be supported in a number of ways. Generally the most satisfactory are the cantilever type supports which can be hung from building steel using a single vertical member. Troughs and racks also may be supported directly from columns or walls. By coordinating design, it is often possible to use the same supports for mechanical tubing. The cantilever supports leave one side of the trough open, so cable may be laid in, where possible, rather than being pulled in as is the case with a trapeze type support. By specifying support spacing of about six feet, the troughs may be loaded to their full capacity without producing excessive deflection. Also, the installation will be strong enough to withstand the abuses encountered during construction when they are sometimes used as walkways or scaffold supports.

With the basic trough system established, you can proceed with the electrical design. As it progresses, prepare cable routing sheets showing the routing of each cable through the various troughs or racks it occupies. These not only serve as a check on the adequacy of the number and size of troughs, but also provide the installation contractor with information needed to install cables in accordance with designers' intentions. Actual location of each cable in a particular trough may be decided by the contractor.

Supporting the cables between troughs or ladders and the terminal equipment is a simple matter. Where distance is short, a conduit or support is seldom required. This can result in a significant saving over a conduit system at control boards, switchgear and similar equipment where multiple cables are involved. For distances longer than two feet, conduit is generally used for isolated runs. The conduit is connected directly to the trough using plates available from the manufacturer.

Analysis of trough and ladder systems shows that they are simpler to design, easier to install and more flexible in design, installation and operation than are conduit systems.



MANOMETERS indicate the vacuum that exists at different areas in the condensers

Condenser tube tests at Edge Moor Station show . . .

High heat transfer for stainless

January 1955 was retubing time for No. 1 condenser of Delaware Power and Light Co's Edge Moor Station. Half the unit was retubed with stainless steel, the other half with arsenical admiralty. Shortly after retubing date, Delaware P&L and the Alloy Tube Division of Carpenter Steel Co started a testing program on this condenser to find: (1) heat-transfer rates (2) condenser absolute pressures and (3) corrosion-erosion resistance of the two metals.

Results to date show stainless tubes producing U values between 90 and 96% of the admiralty results, higher than first believed. Actually HEI values indicate stainless has a U-value ratio of 58% that of admiralty when both tubes are 18 gage.

Edge Moor Station, located near the mouth of the Delaware River, went on line in early summer 1951, with units 1 and 2. In summer 1953, tube leaks appeared. The situation got steadily worse until retubing became necessary a year and one half later. By then 7% of the 6710 admiralty tubes had been plugged; the rest were in poor condition.

River water conditions affecting the condenser swung widely in several values. Temperatures ranged from 32 to 85 F, chlorides from 10 to 5000 ppm, pH from 6.6 down to 3.0. Low pH existed for a few hours each day during the first few months of operation. But neutralizing equipment was added at the circulation-water inlet, keeping pH to 5.0 or higher.

Tube failure was caused by severe pitting, although both thinning and grooving were also present. Small tube groups of 90-10 and 70-30 cupro-nickel and aluminum brass showed about the same service as the admiralty. Two types of stainless steel (317 used in the traveling screens and 302 for the circulating-pump impellers) proved still OK after two years' service.

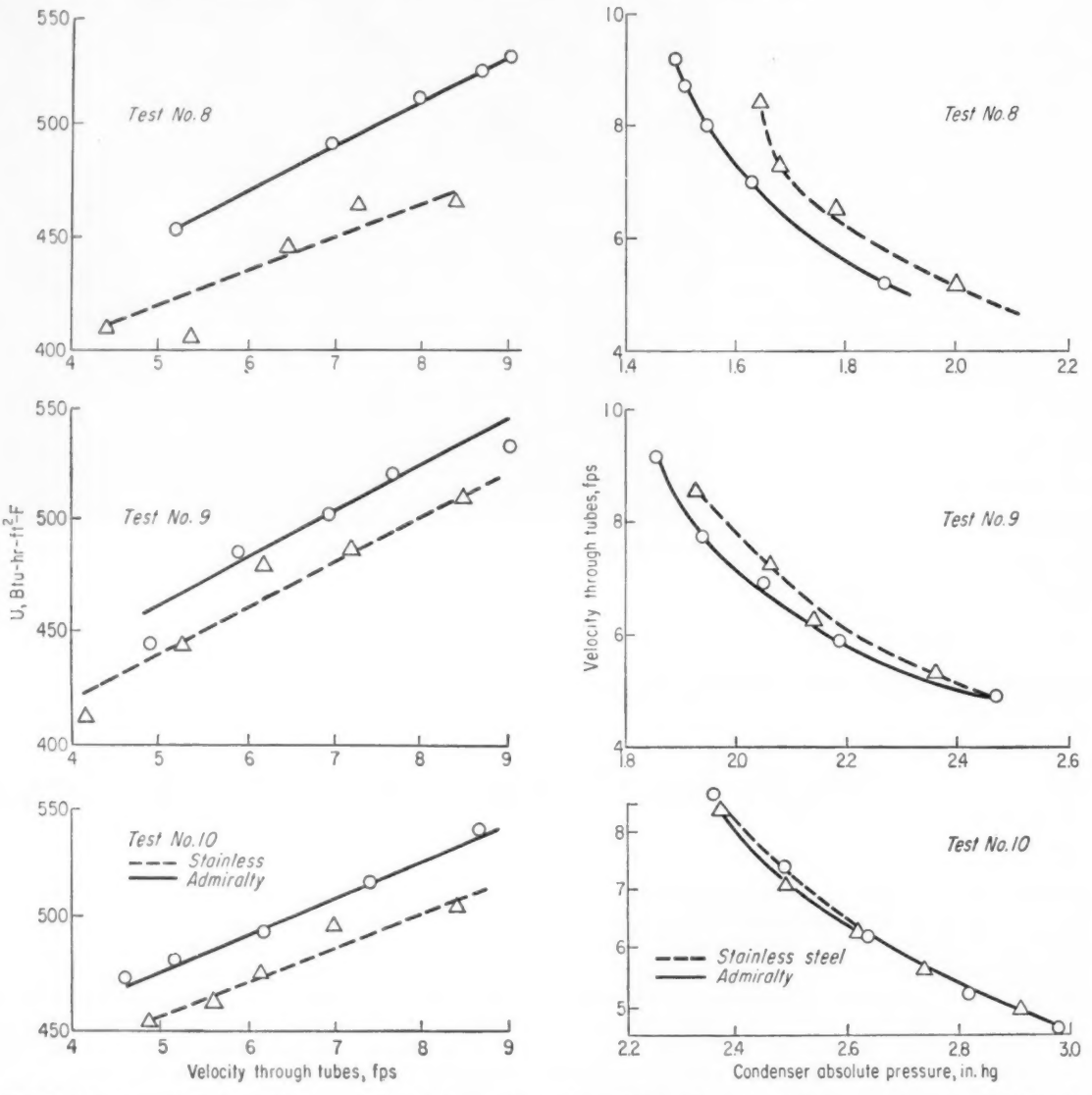
Retubing at this station pointed up need for careful tube-material selection. Because of problems involved, the joint test program was set up and tests started shortly after retubing was completed. Of the 3355 tubes in the stainless side (19,982 sq ft), 2649 were 20-gage type 329; the balance were 18 gage 329 and 20 gage 316. All tubes, both stainless and the 18-gage admiralty, were 7/8-in. OD.

Six tests were run between retubing date and June 1956. Results: inconclusive. Two variables affected usefulness of test results. First, iron deposits appeared in the tubes. Deposits resisted all attempts to remove them by mechanical methods, although acid cleaning proved effective. However, they introduced a hard-to-calculate fouling factor. Second, installing neutralizing equipment changed the circulating-water pH and made meaningful comparison of corrosion resistance difficult.

Last year saw four more tests.

continued

Curves compare U values, absolute pressure with velocity



VELOCITY is the controlled variable in tests. Results show stainless-steel tube heat-transfer rates were higher than anticipated; also stainless tubes gave higher U values than admiralty when difference in velocities between two halves was large enough

About a month before running test No. 7 (March 25th) tubes were shot with rubber plugs. This didn't clear up the deposits so they were acid cleaned. Test results appeared favorable to the stainless tubes since the ratio of heat-transfer rates of stainless to admiralty was over 90%. But a comparison of individual results showed inconsistencies—both the total heat transferred and condenser absolute pressure were higher in the stainless half. Therefore test was not thought valid and was thrown out.

Metal plugs were tried just after test No. 7. These plugs removed scale nicely, eliminating need for frequent acid cleaning. New plugs had been used four times by May 25th, date of test No. 8. This time test results were both favorable and consistent, and were accepted. U-value ratio averaged 91.6 for all velocities.

Procedure for all tests was basically the same, with only small differences cropping up in individual tests. Both halves of the 40,000-sq-ft condenser were tested separately; before taking readings water in the side not in service during the test was drained.

Steam flow to the 60,000-kw turbine-generators was cut to about 300,000 lb per hr, about half load, and stabilized there before first run was made. Five different velocities were then established by throttling the inlet butterfly valve. Half-load steam flow was maintained during all

Test data: Main condenser, Unit 1, Edge Moor Station

	Stainless-steel side (19,982 sq ft)					Arsenical-admiralty side (19,917 sq ft)				
Test No. 8 (inlet T, 66.4 F)										
Velocity	4.4	5.4	6.5	7.3	8.4	5.2	7.0	8.0	8.7	9.2
Heat given up to condenser million Btu/hr (calculated)	215.3	214.6	214.1	213.8	213.3	214.1	213.5	212.8	212.5	212.8
River water rise, F	18.4	14.9	12.4	11.0	9.6	16.6	12.4	10.8	9.8	9.4
Condenser abs press., in. Hg	2.11	1.99	1.78	1.68	1.64	33.0	28.6	26.8	25.7	25.2
Terminal difference, F	36.5	34.6	30.9	29.0	28.2	1.87	1.63	1.55	1.51	1.49
Log mean temp difference	26.3	26.4	24.1	23.0	23.0	23.8	21.8	20.9	20.5	20.1
U values (Btu/hr/sq ft/F)	410	407	445	465	464	453	492	512	522	531
U corrected to 70 F (HEI Book)	422	419	458	478	477	467	507	528	538	547
Test No. 9 (inlet T, 74.0 F)										
Velocity	4.2	5.3	6.2	7.2	8.5	4.9	5.9	6.9	7.7	9.1
Heat given up to condenser million Btu/hr (calculated)	215.3	214.3	213.1	212.8	211.9	215.4	213.4	212.7	212.4	211.8
River water rise, F	18.8	15.2	12.7	11.1	9.4	18.0	14.8	12.4	11.1	9.5
Condenser abs press., in. Hg	2.63	2.36	2.14	2.06	1.93	2.47	2.19	2.05	1.94	1.86
Terminal difference, F	36.6	32.5	29.2	28.1	26.0	34.3	30.5	28.3	26.6	25.1
Log mean temp difference	26.0	24.1	22.2	22.0	21.0	24.3	22.2	21.3	20.5	20.0
U values (Btu/hr/sq ft/F)	414	445	480	484	505	445	483	501	520	532
U corrected to 70 F	406	436	471	475	495	436	474	491	510	522
Test No. 10 (inlet T, 80.7 F)										
Velocity	4.9	5.6	6.2	7.0	8.4	4.6	5.2	6.2	7.4	8.7
Heat given up to condenser million Btu/hr (calculated)	215.6	215.7	215.0	214.8	214.2	217.5	215.0	214.0	213.6	213.0
River water rise, F	16.6	14.4	13.1	11.5	9.6	18.8	16.8	14.1	11.7	9.8
Condenser abs press., in. Hg	2.91	2.74	2.62	2.49	2.37	2.98	2.82	2.64	2.49	2.36
Terminal difference, F	33.1	31.2	29.7	28.0	26.3	33.9	32.0	29.5	27.3	25.1
Log mean temp difference	23.8	23.2	22.5	21.6	21.1	23.2	22.4	21.7	20.8	19.8
U values (Btu/hr/sq ft/F)	453	465	478	498	508	471	482	495	516	540
U corrected to 70 F	431	443	455	474	484	449	459	471	491	514

runs, regardless of condenser water velocity in the tubes.

Condenser vacuum was measured using mercury manometers. Manometer inlets were centered along each of the four condenser top edges and placed about one foot above the tubes. Cooling-water temperature was measured with one thermometer in the inlet pipe and three at 120 deg intervals about the discharge pipe vertical section.

Velocities were maintained for 15 minutes; readings were taken every five. Three sets of readings obtained during each run were averaged and resulting values used to plot against particular velocity. River-water flow in the last three tests was found by calculating heat lost to the condenser and temperature rise of water through the condenser. In previous tests a pitot tube was used to measure flow.

About four days before test No. 9 tubes were again shot with metal plugs. Transfer ratio averaged 95% and condenser absolute pressure in the admiralty side stayed about 0.04 in. Hg below stainless values.

No cleaning was done between tests No. 9 and 10 (August 10th). Tubes inspected just before the test revealed a hard reddish-brown silt on the inner surface. It was not removed. Stainless-admiralty ratio averaged 96%. Condenser pressures in both halves were the same for equal velocities except at 8 fps (here condenser pressure in admiralty side was 0.03 in. Hg lower than the stainless half.

Cleanliness comparisons were figured for last four tests. Calculations show stainless remained relatively clean when results were compared with HEI standards. Admiralty tubes averaged 36% dirtier than stainless, possibly because during summer operation velocity in stainless half was maintained at 8.5 fps but at only 6.5 in admiralty side.

U values for these tests were computed by $U=H/(S)\,(T)$, H being the heat given up in the condenser, S the condenser heat-transfer surface in sq ft (side in service only) and T the log mean temperature difference.

Test results show stainless U values at this station are higher than anticipated and favorable when compared with admiralty in-the-field values. (EDITOR'S NOTE: *Delaware Power and Light Co supplied the data for this article.*)

Why You Get HIGHER EFFICIENCY in a RILEY TURBO FURNACE

The Riley Turbo Furnace, a new concept in furnace design, has created unusual interest in the power industry. Already, in only a few short years since its introduction, twenty-three Turbo Furnace units with a total steam capacity of 14,000,000 lbs/hr have been bought by public utilities and industrial companies. Sizes range from 125,000 lbs/hr to reheat units of 1,650,000 lbs/hr and are being installed for the most part as multifuel units to burn oil, gas and coal. Three units are already successfully burning the newest of petroleum by-products fuels: Fluid Coke.

One of the most attractive features of the Turbo Furnace is its high furnace efficiency. Firing of fuels at the bottom of the circulation system makes possible full utilization of furnace waterwall surfaces from top to bottom and permits higher heat release per square foot of furnace envelope. Vertical displacement of furnace gases results in clean, slag-free furnace surfaces and a uniform distribution of furnace heat across the entire width and depth of the furnace.

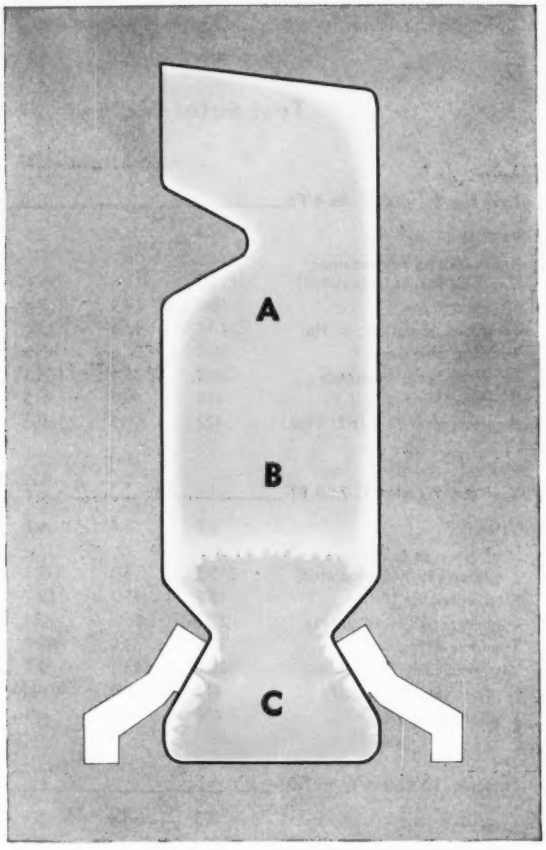


Fig. 1. Flame and Furnace Gas Characteristics of the Riley TURBO FURNACE

High Furnace Turbulence
High Burn Out Rate

As can be seen in the furnace cross section, Figure 1, air and fuels enter the combustion zone of the Turbo Furnace in a downward linear direction from Riley Intertube Directional Flame Burners arranged for opposed firing across the width of the furnace. The opposed streams of fuel and air intermix in the center of the furnace (over the slag pool when pulverized coal is burned) to produce a highly, turbulent area of combustion which fills all the area below the furnace throat. Long residence time of fuels in the area results in a negligible loss of combustibles.

A survey of your plant by a qualified consulting engineer could show ways of making surprising savings in your power costs.

RILEY
STEAM GENERATING & FUEL BURNING EQUIPMENT

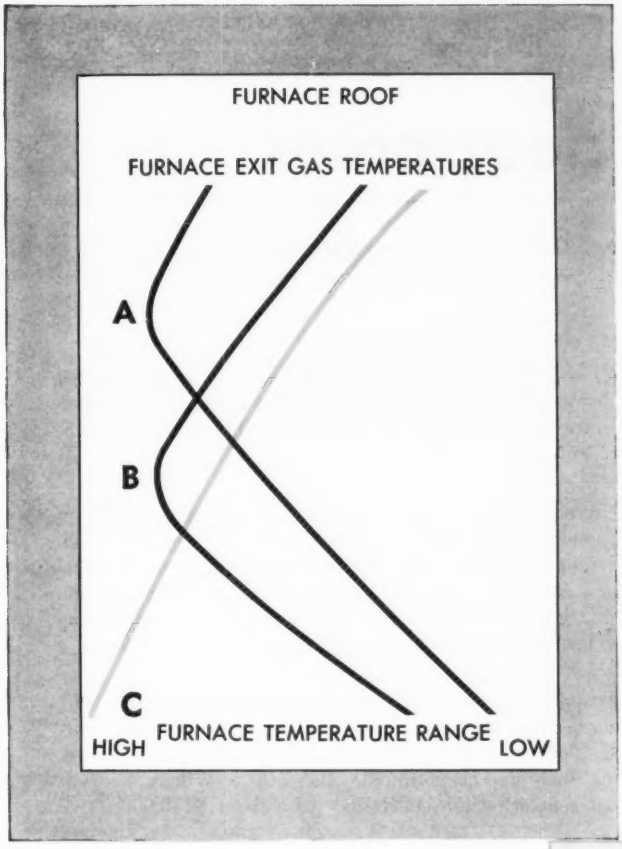


Fig. 2. Furnace temperature curves resulting from heat concentration at various furnace levels. (A) Above center of furnace (B) below center of furnace (C) bottom of furnace

Clean Furnace Walls — No Slagging

Since combustion takes place almost entirely within the furnace bottom very little flame ascends into the upper portion of the furnace. Gases rise vertically without impinging on furnace walls. Heat is released as gases travel toward the furnace exit, cooling to the point where danger of slagging of high temperature elements is reduced to a minimum.

Uniform Heat Distribution At Furnace Exit

A desirable characteristic of Turbo Furnace performance is uniformity of furnace gas distribution across the full width of the furnace. Unusual uniformity in both superheater and reheater metal skin temperatures is now being experienced on a 55 foot wide Turbo Furnace without division walls or waterwall platens.

Uniform Furnace Exit Temperatures With Multiple Fuels

The similar flame characteristics of oil, gas or pulverized coal, the completion of combustion in the confines of the furnace bottom, the cooling effects produced by the full utilization of furnace waterwall surfaces result in (1) uniform furnace exit gas temperatures with a given heat release per square foot of effective radiant surface and (2) a marked similarity in the exit temperature of the three fuels (Figure 3). These characteristics make possible the arbitrary use of gas, oil or a wide range of coals with a minimum amount of steam temperature control.

All Burners at Operating Floor Level

Another feature of the Turbo Furnace about which operating engineers are enthusiastic is the fact that all burners, with their supervision and maintenance, are located on one level. This feature permits the location of firing control on the turbine level.

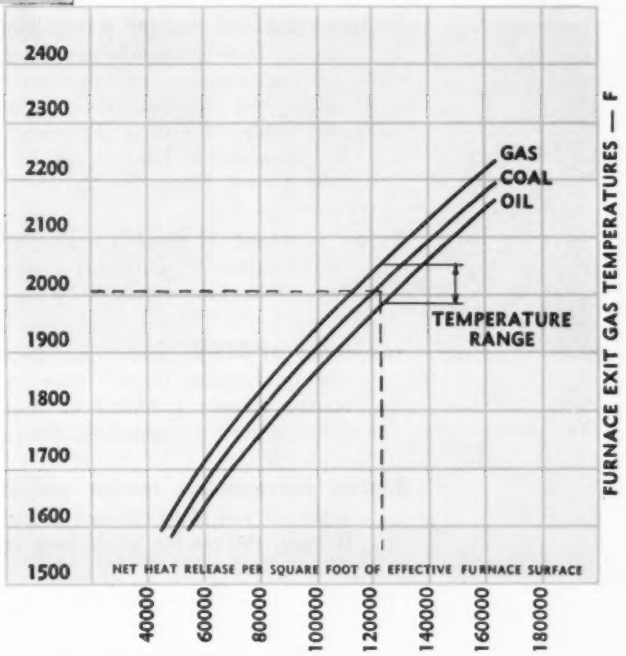
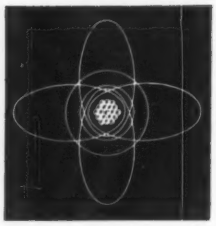


Fig. 3. TURBO FURNACE exit gas temperatures of gas, oil, coal have a maximum variation of approximately 50 F

A Riley engineer will gladly give you complete information about this latest Riley development. Write — RILEY STOKER CORPORATION, WORCESTER, MASSACHUSETTS

For more facts circle 234 on Reader Service Card, p 102



Nuclear notes

By B G A SKROTZKI, Associate Editor

Submarine Seawolf goes out of commission for about a year while its sodium-cooled nuclear reactor is replaced by a pressurized-water unit. The sodium-cooled reactor, which developed superheater trouble during its initial trails, has driven the submersible over 71,000 nautical miles.

Neutron detector developed by Westinghouse Electric Corp uses a tiny slice of silicon or germanium having a p-n junction near the top surface, see *TD* report, p 55. This supports a layer of uranium weighing one millionth of an ounce. Thermal neutrons absorbed by the uranium fission it and the fragments pass through the p-n junction to generate an electrical impulse that can be counted and recorded. The pinhead-sized detector can be inserted into small clearances between fuel plates.

Three new reactor ideas will be studied for AEC if contract negotiations mature: (1) American Radiator & Standard Sanitary Corp proposes a mercury-cooled fast-breeder reactor. (2) General Electric Co proposes a modified sodium-graphite reactor with modules containing fuel and coolant. (3) Babcock & Wilcox Co will study a gas-suspension coolant reactor. Each study may cost about $150,000.

Factory-assembled nuclear power plant has been proposed to AEC by nine manufacturers. These proposals would supply a PWR moderated by light water and fueled with enriched uranium to produce 1 mwe and 2 mwt of space heating. The specifications call for installation at Sundance Air Force Station, Wyoming and completion within 30 months. Proposers are: Alco Products, Inc; Associated Nucleonics, Inc; Combustion Engineering, Inc; Curtiss-Wright Corp; H K Ferguson Co; Lockheed Aircraft Corp; The Martin Co; Westinghouse Electric Corp; Shiflet Bros, Inc.

By an exchange of stock Combustion Engineering, Inc, plans to acquire General Nuclear Engineering Corp and operate it as a subsidiary. Dr Walter Zinn, president of General Nuclear, will be in charge of all of Combustion's nuclear power work.

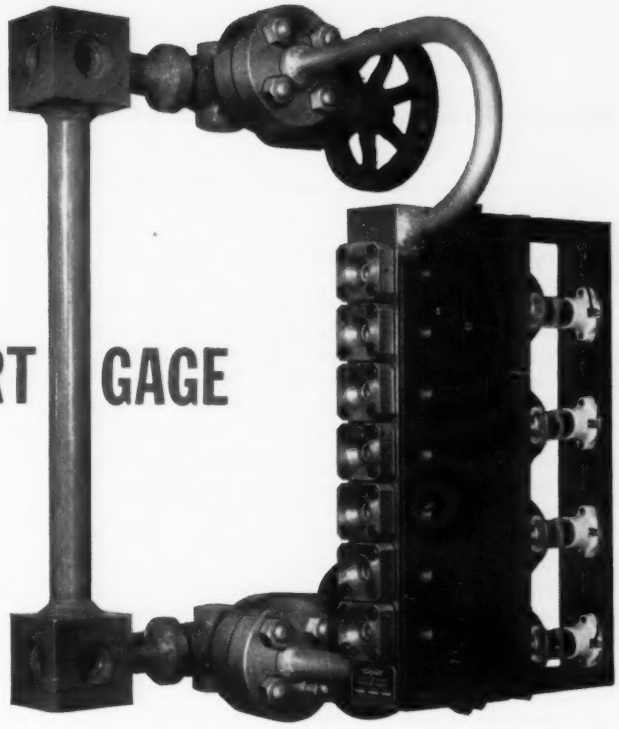
Rebuilding of EBWR (Experimental Boiling Water Reactor) at Argonne National Laboratory, Lemont, Ill, will raise its capacity from rated 20 mwt to 100 mwt. This reactor actually produced 62 mwt last March. Sargent and Lundy will be the architect-engineers supervising the job which will cost about $1.5 million.

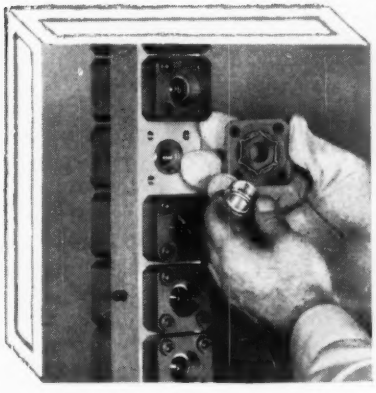
Another homogeneous reactor project goes into limbo with Pennsylvania Power & Light Co and Westinghouse Electric Corp abandoning their proposal to build PAR. If built, the reactor would have cost the companies and AEC about $108 million.

Fuel-cycle development proposals totaled 107 from 39 firms as received by the AEC. These proposals aim to reduce nuclear fuel costs in fabrication and use of reactor elements, removal, re-enrichment and reinsertion in reactor cores.

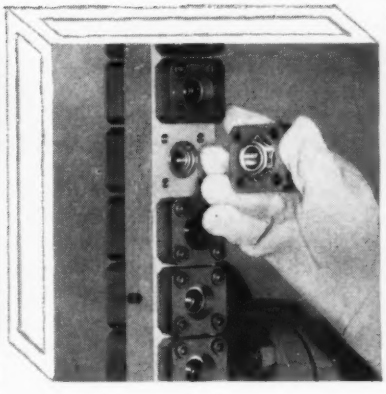
Training program for operating nuclear reactors is offered by AEC at Shippingport, Pa. Duquesne Light Co will run 6-month course for 25 students for the AEC. New class will start every three months beginning Jan 5, 1959. Entrance requirements include knowledge of engineering physics, mathematics through differential equations, chemistry, atomic physics, thermodynamics and electricity. A selection board will choose the students who must pay a tuition fee of $2000.

servicing the new YARWAY COLOR-PORT GAGE is easy as a b c

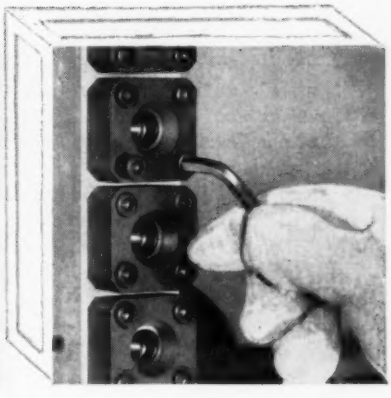




a Remove four cap screws and lift off cover assembly (held in right hand). Install new port assembly (glass-mica-gasket, shown in left hand) in cover. This port assembly is part of the complete cover assembly.



b Re-install complete cover assembly. Sealing gasket automatically seats in gasket groove in body.



c Tighten down four Allen cap screws with standard wrench (no torque wrench required).

New Yarway Color-Port Boiler Water Level Gages (for pressures to 3000 psi.) offer not only this new ease of maintenance but insure brilliant red and green readings of steam and water.

For full details, write for Yarway Bulletin WG-1814.

YARNALL-WARING COMPANY, 100 Mermaid Ave., Philadelphia 18, Pa.
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Reserved for your comment

BOB BELLAS, Associate Editor

It may take a while, but . . .

. . . I should like, if possible, to have A E Kittredge answer the following questions in connection with his article on deaerator performance ("Evaluate your deaerator performance," April 1958, p 88).

Concerning the description "Oxygen remaining in solution . . ." (p 204): Is the value 0.26 times obtained by calculation or experiment? What is the meaning of using centipoise, the unit for viscosity, to express surface tension?

Concerning "Tray-stack design" (p 206), how can the author evaluate "about four transfer units" from equation (1). Isn't it absurd that the right-hand sides of equations (2) and (3) describing different quantities are the same?

Concerning "Temperature" (p 210), shouldn't it be "HTU is inversely proportional to absolute viscosity of water to the 4/3 power," instead of "directly proportional" as it is described?

JYUEMEI KIWAKI, *Professor*
University of Mercantile Marine
Fukae Honjo-Cho, Higashinada-Ku
Kobe, Japan

EDITOR'S NOTE: *Professor Kiwaki's letter bounced quickly along to Assistant Editor Bob Marks, who had handled the deaerator performance story. Just as quickly, Bob sent a reply winging across the Pacific explaining ". . . equations (2) and (3) on page 206 should not be the same.* (POWER *readers who clipped the article for reference please note). Equation (3) should read: HTU = v 4/3 ÷ e. Apparently the right-hand side of equation (2) was recopied in error by the printer and our proofreaders failed to pick it up."*

Bob's note concluded that he was forwarding Professor Kiwaki's queries to the author for his comment. Mr Kittredge had this to say:

. . . The value of 0.26 relating to the oxygen remaining in solution might be said to be about one-third theory and two-thirds test. It was experimentally determined by others that the nucleus size of a gas bubble in cold sea water was a certain finite value. These tests to which I refer were reported in *London Engineering* about 1938. It was theorized by the writer that surface tension was the dominating factor in determination of the nucleus size. This was subsequently proved by tests of deaerating heaters. The tests to which we had access showed the resulting gas content of heated water to be proportional to the residual gases of nitrogen and oxygen when consideration of the reduction of surface tension was made.

A centipoise is a unit of viscosity equal to 1/100 poise, or 1 poise equals 100 centipoises. By a coincidence, the viscosity of water is 1 centipoise at 68 F.

The evaluation of "about four transfer units" from equation (1) comes from the fact that the change of gas concentration within the traystack is 0.245 cc/L when the gas concentration is reduced from 0.25 cc/L to 0.005 cc/L. In the presence of a substantially clean steam atmosphere, the logarithmic mean driving force is 0.06 cc/L and the number of transfer units, equation (1), is 0.245 divided by 0.06, or four transfer units.

The typographical error which occurred, but which has been corrected, explains the absurdity of equations (2) and (3) and also confirms that the original statement was correct. The height of the transfer unit is directly proportional to the viscosity of water to the 4/3 power. In this connection, I am referring to the height of a transfer unit as the height of packing required to perform a certain function. And as the temperature of water is increased, its viscosity is greatly decreased. Consequently the height of a transfer unit as a physical measurement is greatly decreased as stated.

ARTHUR E KITTREDGE
Kittredge Engineering Co, Audubon, N. J.

Another way to skin a cat

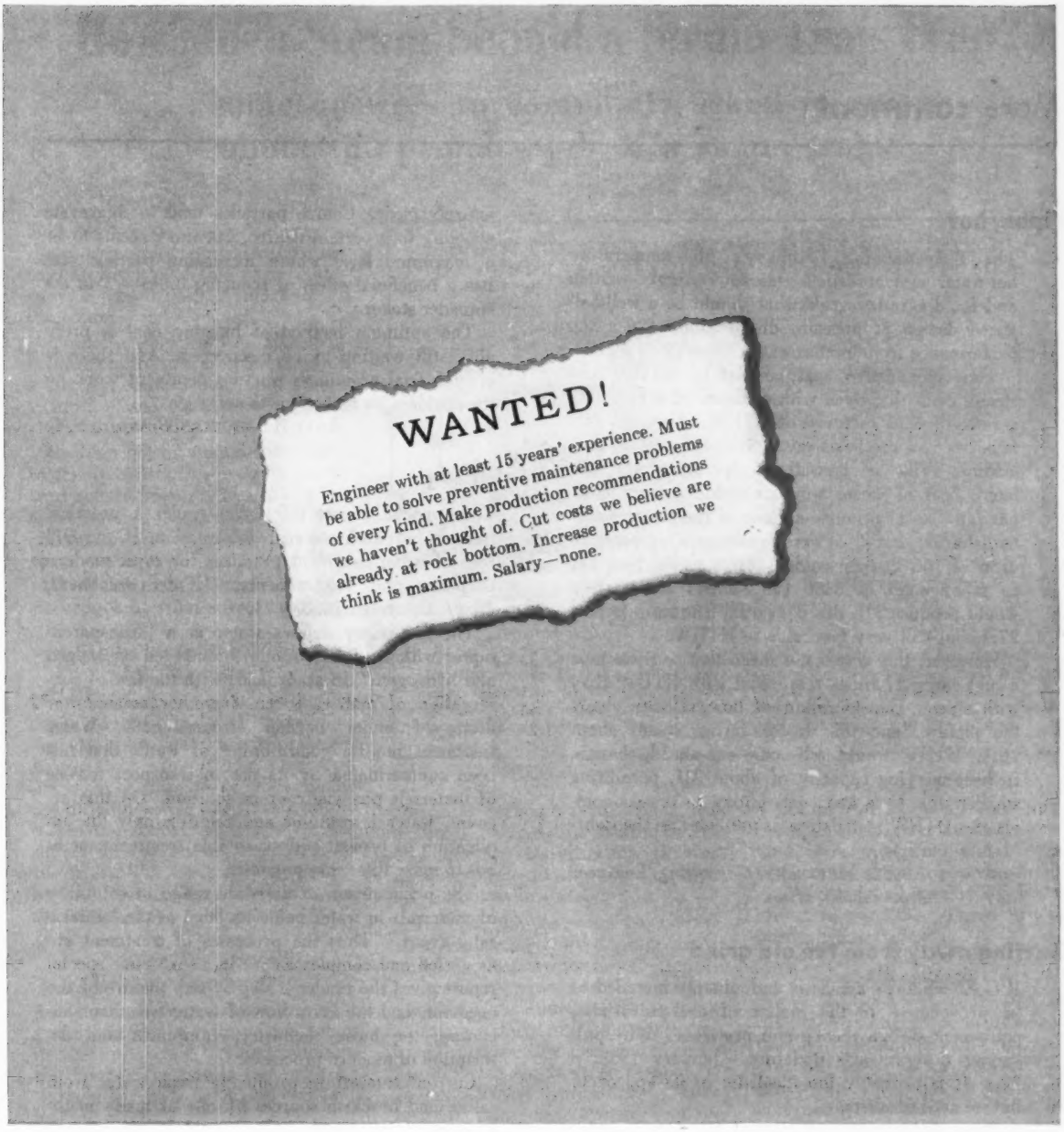
The replies to your question about furnace explosions (*Plant problems*, November 1958, p 124) all suggest that loss of ignition is the condition which must be prevented. True, but a recent furnace explosion here indicates that boiler cleanliness can bear some watching, too.

The boiler was a 125-psi, 15,000-lb-per-hr oil-fired watertube unit. It had been operating almost all summer at minimum firing rate in a central heating plant. Reconstruction of events indicates that unburned oil had collected on some of the sidewall furnace tubes and built up a spongy carbon layer which could soak up more unburned oil. Firing rate had been increased, tubes blown and firing reduced to the former low level about a half-hour before the explosion occurred. Apparently oil in the spongy carbon deposit was vaporized during the high-fire period and hadn't been purged from the furnace and tube banks.

Then . . . whammo! After picking himself off the floor, the fireman found the burner hadn't been extinguished. Electronic flame-failure device was in good order, fireside surfaces were free of soot except for the aforementioned carbon. But boiler's side plates were badly buckled. Moral: Watch those long periods of low fire with an oil-burning boiler.

G V Ross, *Engineering Service Co, Halifax, N. S.*

continued


WANTED!
Engineer with at least 15 years' experience. Must be able to solve preventive maintenance problems of every kind. Make production recommendations we haven't thought of. Cut costs we believe are already at rock bottom. Increase production we think is maximum. Salary—none.

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More **comment**

Piping hot

The Behr-Manning Company's high-temperature hot-water system article was interestingly written and the diagram reveals what should be a well-balanced design of pressure distribution. ("Get top performance from h-p hot water," Dec 1958, p 110).

The comparative heat content of HTHW and steam, evidently given with a datum of 0 F, shows a ratio of 43:1 in favor of HTHW. Although this is correct on the basis given, it could well be misleading. The return-water temperature and the latent heat of steam would provide a truer comparison. No mention was made of the return-water temperature, but if we were to assume a temperature drop of 166 F, this would show a useful heat per cu ft of water of 8380 Btu. Steam at 165 psia would produce 312 Btu per cu ft. The ratio is now 27:1, but still very favorable to HTHW.

However, this would not mean that a given pipe would carry 27 times more heat with HTHW than with steam. Consideration of flow velocity enters the picture, and this factor favors steam about 10:1. HTHW would still come out ahead, though, in heat-carrying capacity of about 3:1, permitting smaller pipe sizes and contributing to the economics of a HTHW installation as presented in the Behr-Manning article.

AUSTIN MCINERNY, *Consulting Engineer Minneapolis, Minn.*

Getting away from the old grind

R G Elmendorf's article is undoubtedly intended to be provocative in the matter of coal-pulverizing equipment design theory and practice ("Why pulverizer design needs updating," January 1959, p 72.) It is probably too idealistic in its approach, but we need idealists.

The graphic representation of the factors influencing combustion efficiency and the byproduct effects is a very good one. It establishes a clear picture of the separate but related factors of influence. This helps to avoid over or underemphasis on the individual items if they should be considered separately.

Mr Elmendorf is correct in saying that pulverizer design has been rather static for many years. Designers have refined the old basic designs but there is room and need for a major breakthrough; something akin to the cyclone, which is a crusher-burner system. However, the matter of obtaining better classification of product is always a difficult one. Cost of improvement—considering increased power needs and wear—becomes a deterrent to optimum fineness performance.

Too, the effect of fineness on slagging is not entirely clear. Coarse particles tend to aggravate slagging to a certain degree, but there seems to be a maximum level where increasing particle size has a beneficial effect of scouring tubes— *à la* the spreader stoker.

The optimum method of burning coal is probably still waiting to be discovered. And there is enough coal around to warrant plenty of work on the problem for some time to come.

LYLE B SCHUELER, *Beaufort, S. C.*

Water log

Your special report offers the reader a practical treasury of authenticated information of the full role of water-treatment practices for most modern purposes and requirements. (*Water treatment, Part I*, December 1958, p 73).

The dictionary defines water as a "transparent liquid without color or odor, composed of oxygen and hydrogen." In accordance with the law of conservation of matter, water is neither created nor destroyed under normal circumstances. Water treatment implies conditioning of water that has been contaminated by its use to transport masses of materials physically or in solution. On this account, water is reusable and requires only the application of proven and acceptable treatment methods to make this reuse possible.

The phenomenon of the wide range of solubility of materials in water befits its label as the "universal solvent." Thus the processes of treatment are as varied and complex as are its uses. Your special report gives the reader a step-by-step picture of the need for, and the know-how of water treatment, including the basic chemistry, equipment and description of modern processes.

Current interest in producing fresh water from saline and brackish sources by one of many methods now under investigation would be appropriate in this section. Treatment and reuse of waters from sewage plant effluent also warrants consideration. Final treatment of these waters after desalting by distillation, freezing, electro-dialysis, etc, to produce a usable water, can be accomplished with the methods outlined in this special report.

P F BAGGISH, *Ebasco Services, Inc, N. Y.*

EDITOR'S NOTE: *This comment by Phil Baggish is but a sample of the mail we're getting from engineers and specialists in the important field discussed in Bob Marks' special report. Deadlines prevented us from using more this month, but we're giving them top billing in the next issue which will include Part II of the report. We extend an open invitation to all to tell us what you like—or dislike—in the report or other pages of* POWER.

How Much Steam Should a Steam Trap Trap?

. . . some answers to commonly asked questions about the primary job of a steam trap

You don't need a doctor's degree in thermodynamics to answer the question at the top of this page. Naturally, a steam trap should trap *all* the steam.

Unfortunately for you, the problem isn't quite that simple. After all, a shut off valve would trap all the steam . . . and condensate, and air, and carbon dioxide as well.

So we'd better amend the answer to the question this way: A steam trap should trap *all* the steam but *must* remove condensate, air and carbon dioxide as rapidly as they accumulate.

With this established, let's take a closer look at what's involved:

A Steam Trap Should Trap All The Steam

If you've had experience with several different makes of traps, you already know that some trap steam better than others. The operating principle of the trap is what makes the difference. We like to talk about it because Armstrong traps are designed so that no steam can get to the orifice. The valve is always water sealed. Result: *More efficient steam utilization, lower fuel costs.*

A Steam Trap Should Remove Condensate

All traps remove condensate—after a fashion. For maximum efficiency in the unit being drained, though, the trick is to get it out without waiting for it to cool and without leaking steam.

Armstrong's water sealed valve takes care of steam leakage. The inverted bucket operating principle opens the trap for water regardless of its temperature. This means you get the condensate out as quickly as it accumulates. Result: *Higher temperatures and better heat transfer in steam heated units.*

A Steam Trap Should Remove Air and CO_2

Part and parcel of the condensate removal problem is removal of air as well as oxygen and carbon dioxide—two real troublemakers. Air tends to reduce operating temperatures and interfere with heat transfer. CO_2 goes into solution to form corrosive carbonic acid which, for example, can eat unit heater tubes. O_2 aggravates the situation. Believe it or not, but all traps don't properly remove air and CO_2.

By now, you've probably guessed that Armstrong traps *do* remove air and CO_2. Armstrong design (see illustration) provides continuous venting of air and CO_2. By opening suddenly, the Armstrong trap creates a momentary pressure drop to "pump" the air down to be vented. Result: *Higher temperatures, faster heat-up, better heat transfer and reduced corrosion.*

Note: When required, specially sized air vents are furnished. For fast heat-up of low pressure on-and-off units, Armstrong provides open float and thermostatic air vent traps.

What's the Final Answer?

Summing it all up, you'll get the best service from steam heated units that are equipped with traps designed to trap *all* the steam and remove air and condensate as quickly as it accumulates. In our prejudiced viewpoint, this means Armstrong traps. More important are the several thousand users of Armstrong traps who have proved the point.

Before you make up your mind, though, consider the minimum maintenance requirements of Armstrong traps . . . and the convenient assistance your local Armstrong Representative provides. These are important plus values.

Put Up or Shut Up

We're so confident that we "put up". Armstrong traps are unconditionally guaranteed to satisfy. So you can find out for yourself with practically no risk. If you're not completely satisfied with the way they do their job, you can get your money back.

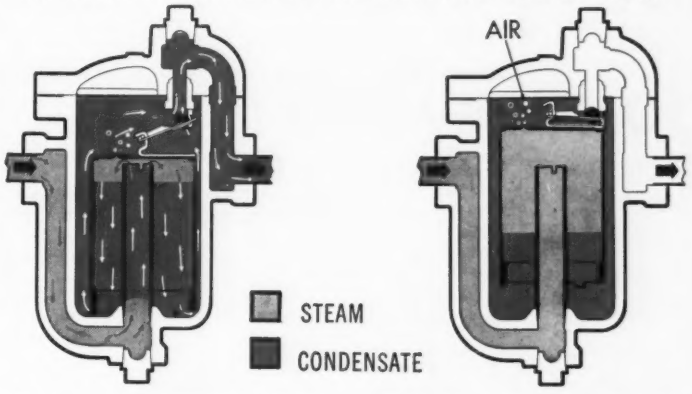
* * *

The 44-page Armstrong Steam Trap book goes into greater detail on these and other Armstrong features. It also discusses trap selection, installation and maintenance. Ask your Armstrong Representative for a copy or write

Armstrong Machine Works
8125 Maple Street
Three Rivers, Michigan

ARMSTRONG STEAM TRAPS

HERE'S THE STEAM TRAP DESIGN THAT GETS RID OF CONDENSATE AND AIR WITHOUT STEAM LOSS



Trap open. Condensate entering trap has caused bucket to lose buoyancy. Weight of bucket times leverage pulls valve open. Air is discharged along with condensate.

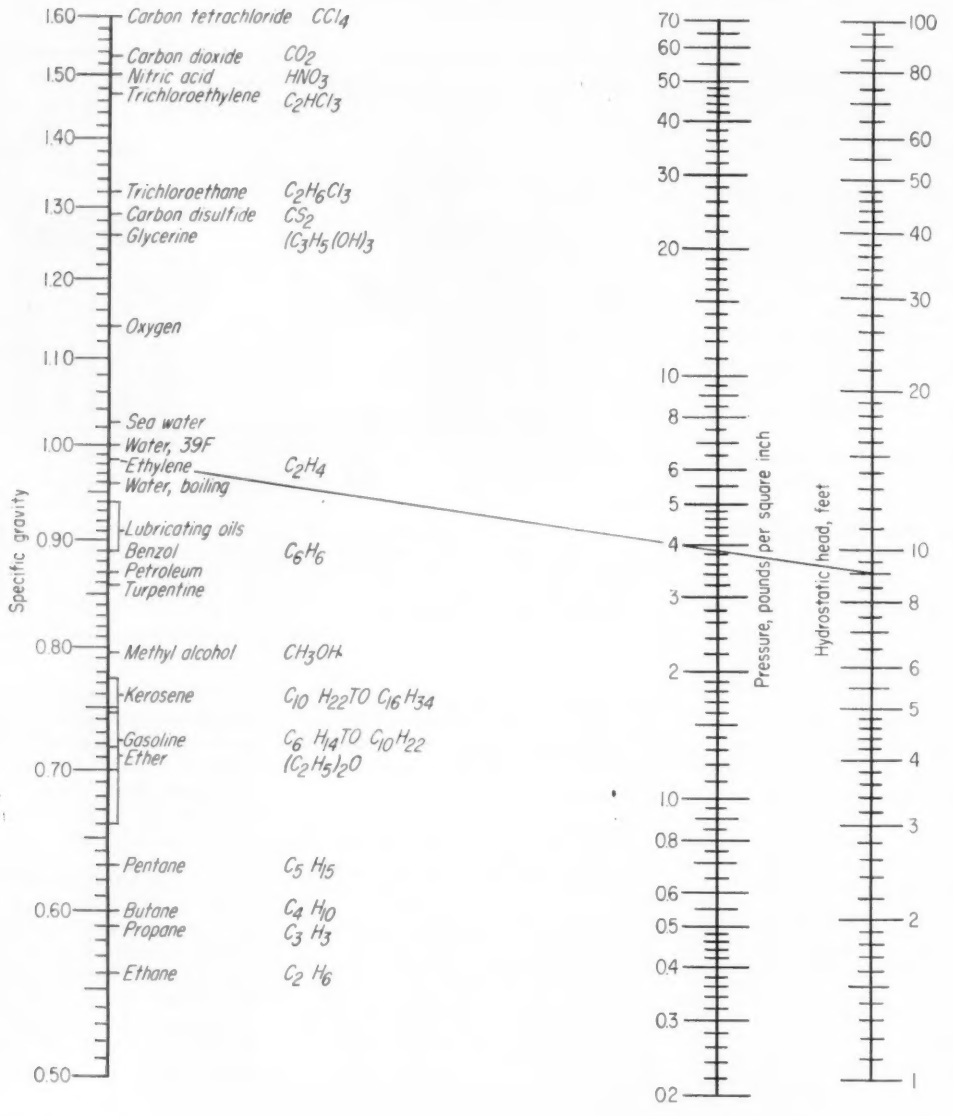
Trap closed. Steam has floated inverted bucket; valve is held tightly closed by system pressure. Air entering trap passes through bucket vent and accumulates at top of trap.

For more facts circle 237 on Reader Service Card, p 102

Perforated for your filing ease

Power's data sheet

No. 318

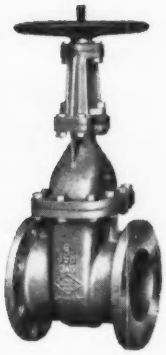


Hydrostatic head of liquids

In designing equipment and piping we often must convert feet of head of a liquid to psi. The relationship depends on the specific gravity of the liquid. This nomogram quickly relates these three factors and lists the specific gravity for a large variety of industrial liquids.

Example: Find the pressure under 9 ft of ethylene. First find the sp gr of ethylene on the left-hand scale; connect it with a straight line to 9.0 on the right-hand scale. Find the answer at the intersection with the center scale, 3.9 psi. —S Salva, *Jackson, Mich.*

© POWER



In this **Split Wedge Gate**

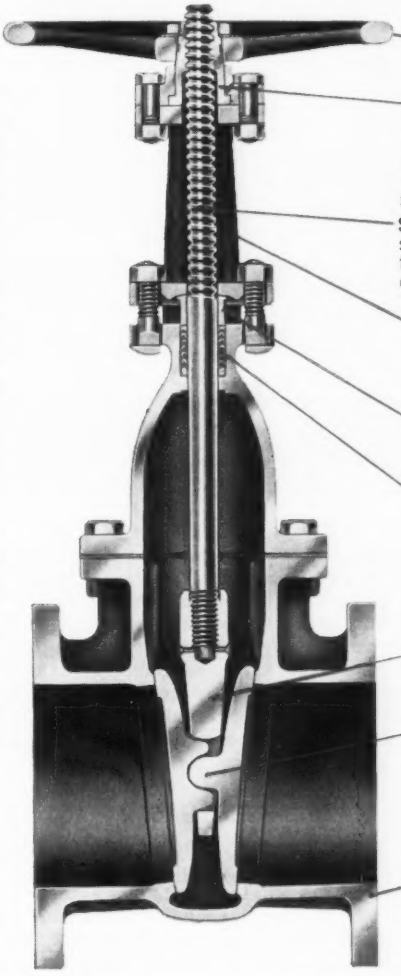
you can see why it pays to

Specify JENKINS for STAINLESS STEEL Valves, too

This picture shows the many points of excellence in the design and construction of Jenkins Fig. 1327 Split Wedge Stainless Steel Gate Valves. Compare them with any valve you know. You'll conclude that it's hard to beat Jenkins at making valves, no matter what the material.

But no picture can show the quality of the castings . . . the precision machining . . . the rigid inspection and testing that have gone into this valve. All of these are as important as design and metal alloys in assuring long, dependable, economical valve service. And, all of them are up to the peak standards for which Jenkins has been known for almost a century.

SEND FOR NEW CATALOG of Jenkins Stainless Steel Valves. You'll find in it the patterns you want, in a choice of alloys that satisfy the requirements of practically all corrosive services. Also, you'll see that these Jenkins valves meet valve industry specifications and the high standards established by the leading users of stainless steel valves. Jenkins Bros., 100 Park Avenue, New York 17.



WHEEL of high strength malleable iron designed for firm grip and easy operation.

YOKE BUSHING, easily renewable. Made of bronze, for ideal thread engagement with stainless steel spindle, to prevent seizing or galling of spindle threads. Bushing of stainless steel is optional.

SPINDLE has long thread bearing surfaces with correct lead for easy, tight closing. Screws into wedge carrier, then secured by a stainless steel pin.

YOKE BONNET has liberal space between yoke arms for easy access to packing box. Precision machined flange face assures uniform contact with gasket for a tight body-bonnet joint.

GLAND consists of two pieces — gland flange and gland follower — eliminates binding of follower in case gland bolts are tightened unevenly.

PACKING of Chevron-type Teflon in large packing box prevents leakage. Only a minimum load is required on gland, extending service life of packing.

WEDGE CARRIER connects wedge to spindle and raises or lowers it. Husky in size to stand any operating strains.

SPLIT WEDGE is the ball-and-socket design which automatically adjusts to the tapered seating surfaces for positive shutoff. The discs, revolving freely in the wedge carrier, produce a self-cleaning action on seating surfaces and reduce possibility of galling and seizing.

BODY —Through-port design for full, free flow. Ample wall thickness and good design provide extra strength to withstand stresses. End flanges conform to M.S.S. specs.

JENKINS
LOOK FOR THE JENKINS DIAMOND
VALVES
JENKINS SINCE 1864

Sold Through Leading Distributors Everywhere

JENKINS BROS., 100 Park Avenue, New York 17, N. Y.

☐ Send the new stainless steel valve catalog

☐ Have a representative call on me

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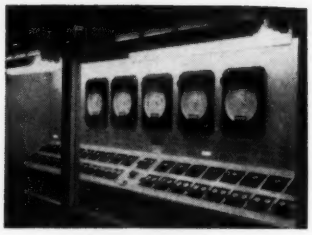
For more facts circle 238 on Reader Service Card, p 102

HAGAN NEWSLETTER
Behind the Panel



AUTOMATIC DATA LOGGING FOR NATION'S FOURTH LARGEST WATER SYSTEM

A 158-year-old water works system, taking the first step toward full automation, is installing telemetering and micro-wave facilities to feed data from 92 remote locations throughout their 12 water districts to a Hagan Kybernetes Data Handling system installed in a central building—the Load Control Center. The data includes such items as: water levels, river elevations, pumping rates, pumping pressures, water flow, and other information to provide an operator at the Load Control Center with an instantaneous picture of events throughout the whole water works system.

High and low limits for every point can be fixed from the central system and such off-normal conditions as unexpected level changes, distribution pressure drop, rise in river height will be detected by visible and audible alarms from the Kybernetes system, as well as red printing on the log sheets where the data system is recording all the variables. Normal operation calls for print-out every hour, but it may be obtained at any time—as well as printing special continuous readings on any point experiencing off-normal conditions. Hagan also furnished the main control console and a graphic wall panel. (Item B-1)

HIGH EFFICIENCY DUST COLLECTOR PAYS FOR ITSELF IN TWO WEEKS

Uranium dust in the atmosphere at a uranium ore reduction plant had become an irritating air pollution problem—as well as a source of loss of the valuable ore dust. A Hagan Aerostatic Dust Collector was installed at the rod mill in the plant and has been operating at 97.7% efficiency—recovering so much uranium dust that it paid for itself in two weeks. The collector has shown no signs of wear or tube plugging. In fact, one plant official said, "This is the first mechanical collector I have ever come across that is actually self-cleaning." At another installation where blast furnace slag dust is being collected, the Hagan unit was inspected after 15 months' service. More than 160 tons of abrasive dust had passed through the tube that was cut in half for examination, yet no wear was visible. In fact, most of the mill scale was still intact. (Item B-2)

METER ACCURACY TEST . . . 1 + 1 + 1 + 1 = 1

The odd looking formula above refers to a utility installation where Hagan Ring Balance meters are in service for all principal metering. The first four figures represent four Ring Balance meters which measure these flows: 6th extraction stage, 9th extraction stage, 12th extraction stage and condensate. A fifth meter measures steam flow to the turbine. In other words, the fifth meter measures steam before the turbine while the totals of the other four meters represent steam recovered after the turbine. Ideally, these totals would be the same. At the end of a nine month period the sum of the four meters was compared to the total recorded on the fifth and the figures were within 2.4% of each other, despite the fact that more than three-quarters of a billion pounds of steam had passed through the system over this period. (Item B-3)

SUPER-SONIC MISSILE TESTS IN LESS THAN 30 SECONDS

Snap a huge valve open in a fraction of a second—let a 3000 mph gale blow through for a few seconds—keep this supersonic hurricane constant in a test chamber—all this in less than 30 seconds. Next, volumes of data from brief tests like this are analyzed to know, in advance, if your missile or aircraft is ready for flight. This is what happens in a blowdown wind tunnel where Hagan PowrAmp control systems meet and exceed rigid specifications for split-second accuracy and reliability. At one blowdown tunnel where PowrAmp transducers, amplifiers, computers, electro-hydraulic pilot valves and operators are installed at critical control points, the tunnel was "blown in" for its first test without aid from Hagan engineers, who were available, but were not needed after the PowrAmp equipment had been installed and adjusted. (Item B-4)

HAGAN CHEMICALS & CONTROLS, INC.

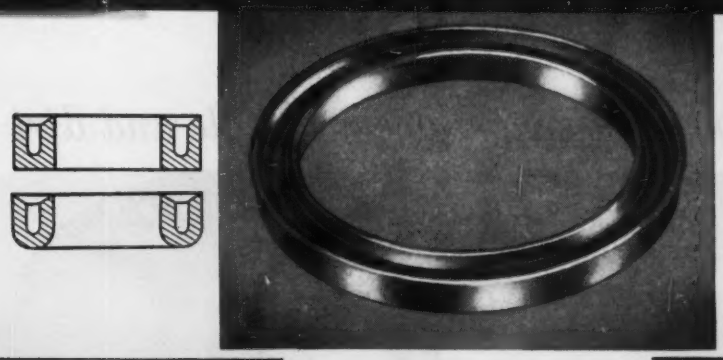
Hagan Building, Room 701, Pittsburgh 30, Pa.

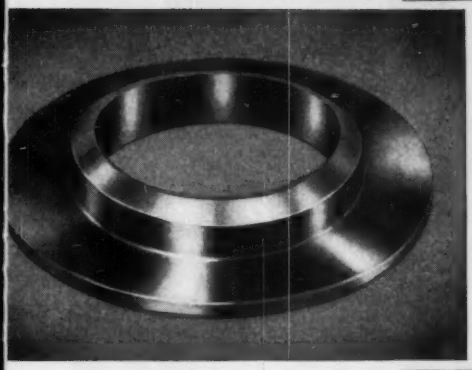
If you would like more information on any of the above items, check the appropriate box below.

☐ Item B-1 ☐ Item B-2 ☐ Item B-3 ☐ Item B-4

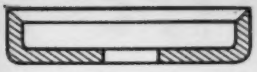
For more facts circle 239 on Reader Service Card, p 102

For more facts circle 240 on Reader Service Card, p 102 ➤





PRECISELY DIMENSIONED* U's, CUPS, FLANGES



ANCHOR "anti-friction" PACKINGS

Find It Fast in the "Yellow Pages"

insure a tight seal...increase the life span of your machinery...new or old!

Those perfect packing rings you see are adding precious *extra hours of trouble-free service*—in countless hydraulic installations, everywhere.

Precision formed from special compounds cast in accurately dimensioned molds, Anchor Cups, Flanges and U-Rings are designed to seal efficiently at low friction . . . to assure maximum life and minimum wear to packing and moving parts. If your need is for a sturdy ring for use against solvents, oil, gasoline, water or air, specify the heavier Anchor Style 11. Or, for a very sensitive packing to be used with worn or scored cylinders and rods, Anchor Style 43 with greater flexibility, is ideal.

Why not try these high quality Anchor products now, and gain the advantages of a packing engineered for your specific application. And, whenever you have a packing problem, consult your local Anchor Representative; he is an expert, and he will gladly help you. You can have information on the many Anchor products just by writing for our catalog.

*Write for detailed circular listing sizes.

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● FIBROUS AND METALLIC PACKINGS FOR EVERY INDUSTRIAL PURPOSE

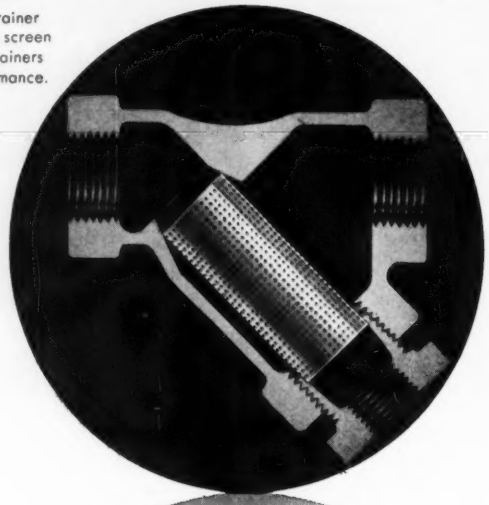
protect your equipment against scale and dirt

Exterior view of NEW Sarco Type "AT" Pipe Line Strainer. Note 45° blow-down angle to facilitate piping away from strainer.

with this

NEW SARCO TYPE "AT" PIPE LINE STRAINER

Cutaway of NEW Sarco Type "AT" Strainer shows sediment collection chamber below screen. Standard screen used in Sarco "AT" Strainers is key to their uniformly successful performance.



Examine one of the new Sarco Type "AT" Strainers and you'll notice at once that its design is a marked improvement over that of contemporary strainers . . . in three important ways:

The Sarco screen, key element of the unit, fits tightly into a long, tapered screen seat. This feature absolutely stops the by-passing of particles around the screen. Secondly, the rigid, welded construction of heavy-gauge brass makes sure the fit will remain tight, even when trapped sediment builds up pressure.

Third, you'll see that the new AT is easy to clean. No sharp edges or weave crevices in the screen for particles to cling to. Blow-down cleaning is simplified by the 45° angle construction.

Write for Sarco Bulletin No. 1210B which gives dimensions, capacities, and technical data. 7317-B

NOTE THIS ADDED PROTECTION AND CONVENIENCE

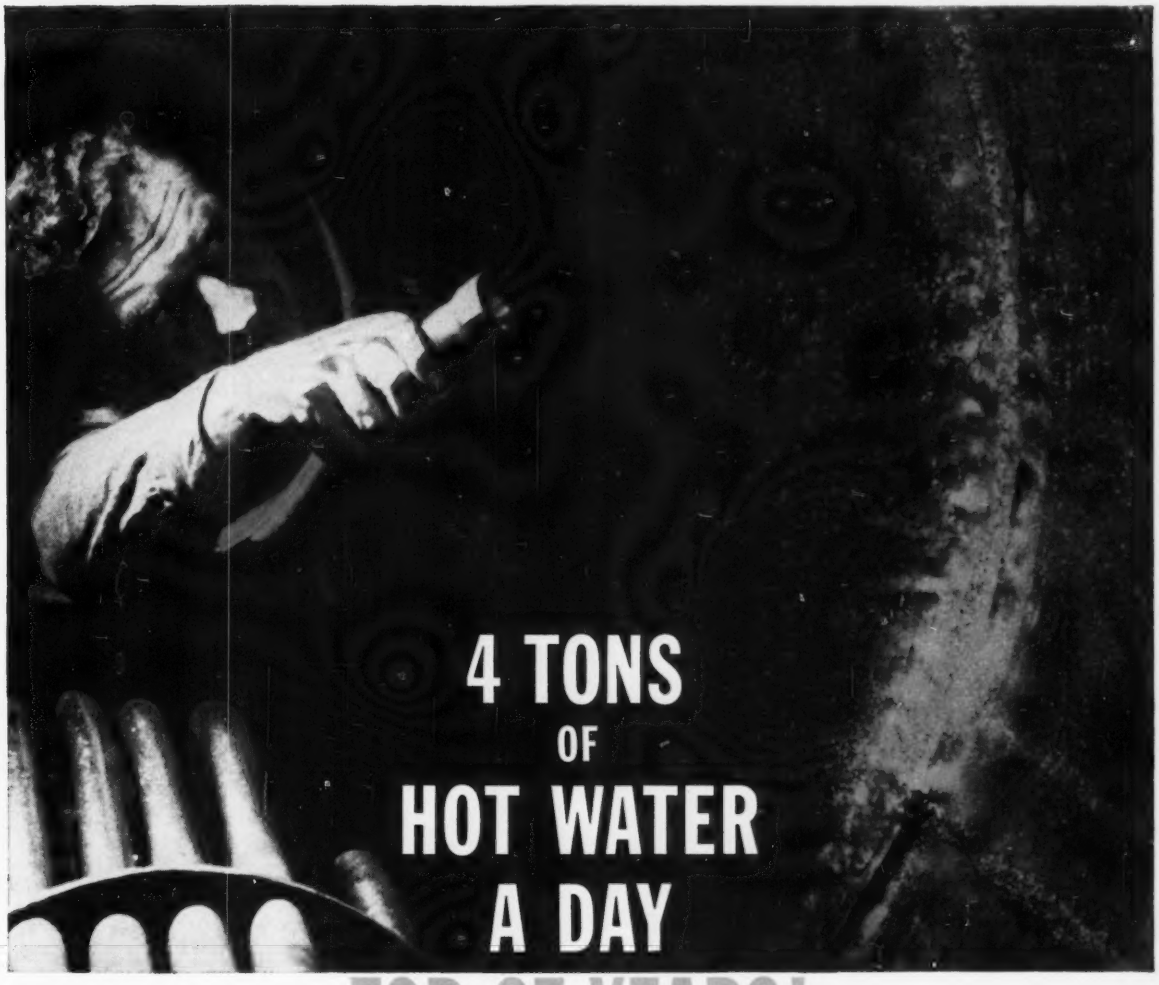
1. Bodies of heavy-duty 250 psi semi-steel. Tensile strength to 30,000 # per square inch minimum.
2. For maximum strength, bodies are reinforced with external rib.
3. Long, tapered screen seat assures correct screen position and tight fit without buckling.
4. Cap design provides a sediment collection chamber below screen.
5. Generous proportion of open screen area in relation to pipe size minimizes pressure drop.

SARCO
COMPANY, INC.
635 Madison Avenue, New York 22, N. Y.

STRAINERS • STEAM TRAPS • TEMPERATURE CONTROLLERS • HEATING SPECIALTIES

For more facts circle 241 on Reader Service Card, p 102

R. B. Scally, stationary engineer at the Bronx (N. Y.) County Building, checks the interior of the P-K copper-lined storage water heater which has been in continuous use for 27 years. Annual inspections always show the unit to be in first-class condition.



FOR 27 YEARS!

...that's the no-trouble service record of this P-K copper-lined storage water heater

Back in 1932 this P-K copper-lined storage heater was installed in the Bronx County Building, in New York. Since that time, it has processed 8½ million gallons of rust-free hot water at 140° F. The unit is inspected annually; "And," says John Bennett, the building's senior stationary engineer, "we always find it in excellent condition."

Why users expect—and get—maintenance-free operation from P-K's Copper-Lined Heaters

Steel shells of P-K copper-lined storage water heaters are double butt welded. All inside welds are ground flush, and the stored hot water contacts only copper or copper-silicon. Expansion joints in the lining, placed every 12", allow longitudinal expansion. All couplings and fittings are of copper-silicon. Couplings are heavy, reinforced forgings welded to both sides of the lining. Wherever they are used, P-K storage heaters are running up impressive performance records. *Patterson-Kelley Co., 2502 Warren St., East Stroudsburg, Pa. 4*

Send for your copy of this latest P-K Data File No. 16 on Copper-Lined Storage Water Heaters

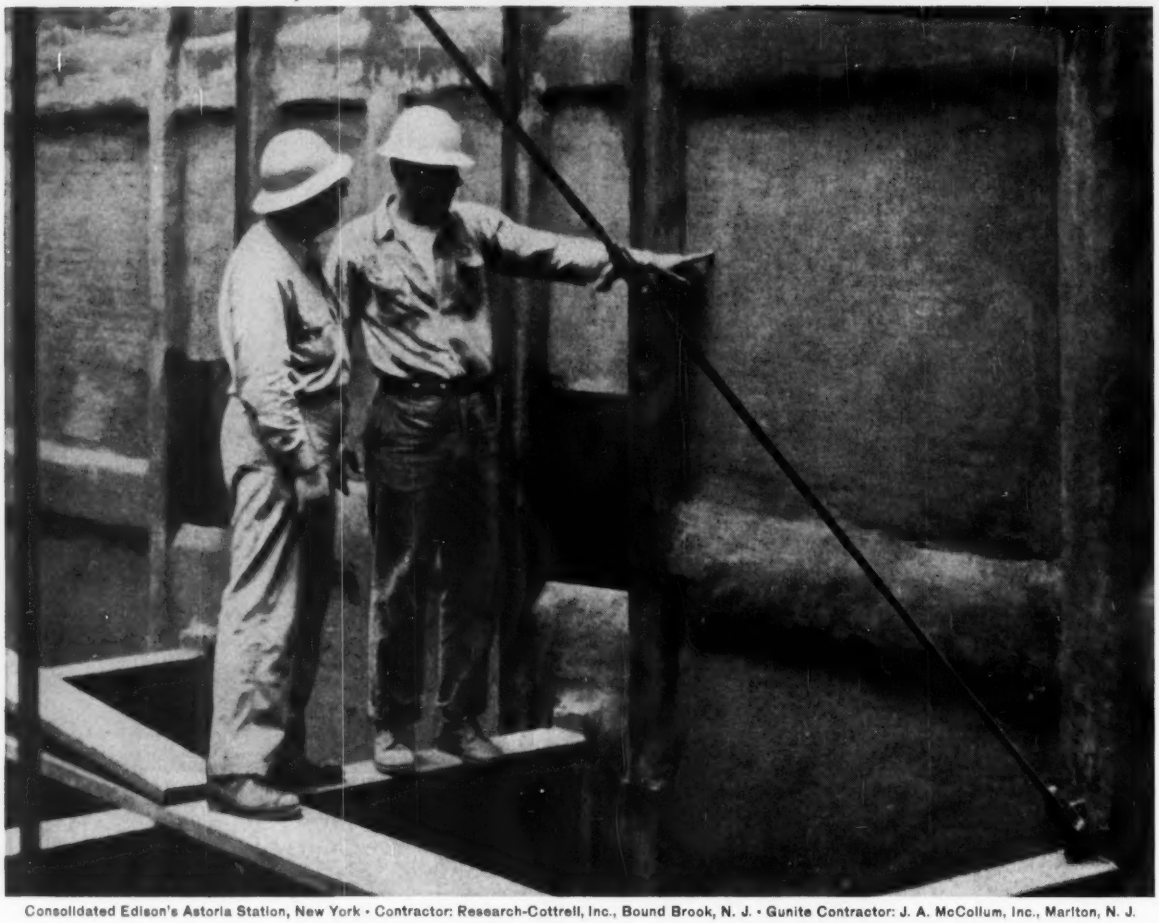
Patterson Kelley
Water Heater Division

storage water heaters • instantaneous heaters • convertors • water to water exchangers

For more facts circle 242 on Reader Service Card, p 102

Con Edison cuts corrosion

Lines its new precipitator with corrosion-resistant concrete made with Atlas Lumnite Cement



Consolidated Edison's Astoria Station, New York · Contractor: Research-Cottrell, Inc., Bound Brook, N. J. · Gunite Contractor: J. A. McCollum, Inc., Marlton, N. J.

To withstand the corrosive effects of fly ash and gases that will soon be punishing this new precipitator, a corrosion-resistant concrete lining made with Lumnite cement was installed. Industrial concretes made with Lumnite calcium-aluminate cement and suitable aggregates resist heat, thermal shock and abrasion, as well as corrosion. Poured, plastered or gunited, such concrete linings place easily (reaching full service strength within 24 hours) and provide good insulation. For convenience, manufacturers of refractories offer castables made with Lumnite cement, packaged mixtures ready for use with just the addition of water. For more information, write Universal Atlas, 100 Park Avenue, New York 17, N. Y.

"USS," "Atlas" and "Lumnite" are registered trademarks. L-179

Universal Atlas Cement Division of United States Steel

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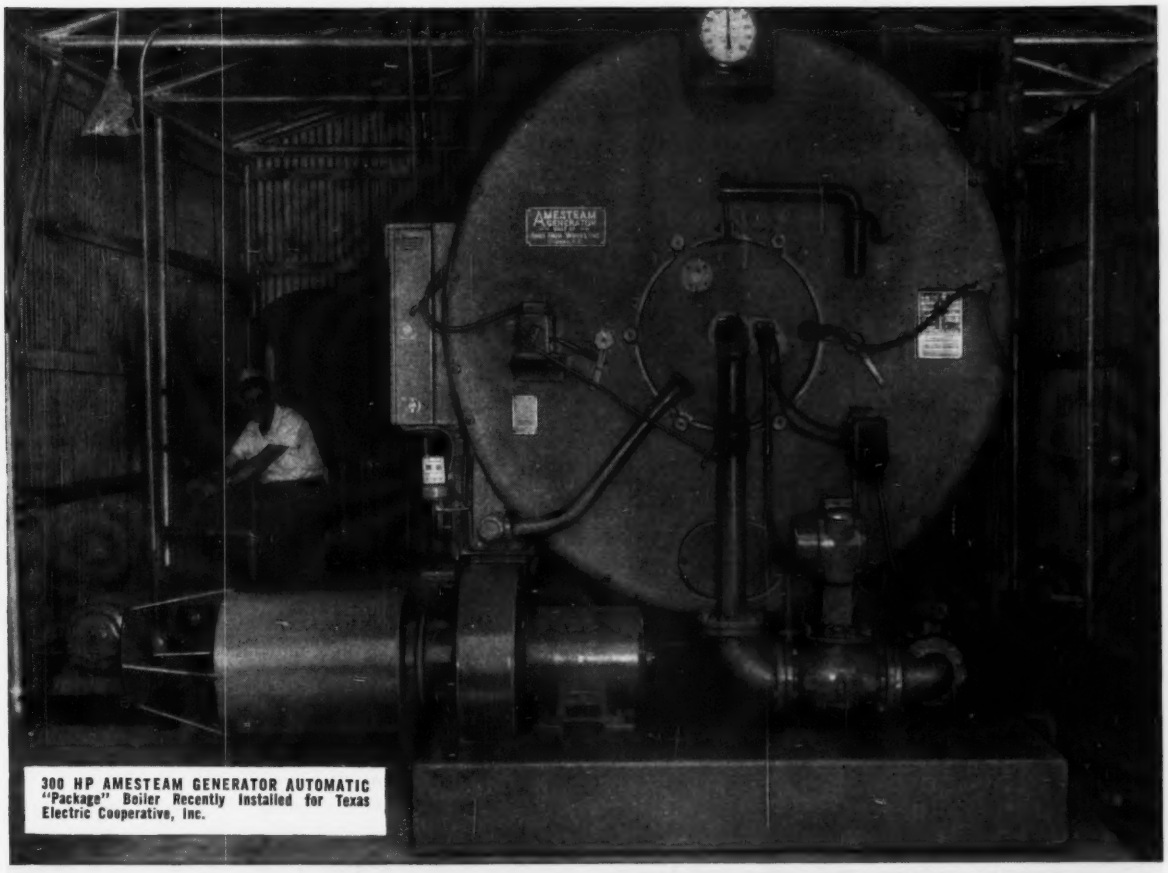
For more facts circle 243 on Reader Service Card, p 102



300 HP AMESTEAM GENERATOR AUTOMATIC "Package" Boiler Recently Installed for Texas Electric Cooperative, Inc.

TEXAS ELECTRIC COOPERATIVE, INC.

Cuts Fuel Consumption Over 36%
Saves Over $15,000 per year
...with AMESTEAM GENERATOR

We Quote the Money-Saving Facts:

"We were very pleased when we replaced two gas-fired boilers in our presssure testing plant with one new 300 HP AMESTEAM GENERATOR Automatic "Package" Boiler. The new Ames unit has reduced our fuel costs alone by 38% ...a saving of *$7,800 per year.*

"Because our new AMESTEAM GENERATOR is entirely automatic, three firemen are now transferred to other duties. This results in an additional saving of *$7,200 per year.*

"This total saving of *$15,000 per year* does not include the considerable savings in maintenance costs. On top of this, the new Ames installation increases our production potential by 20% to 30%... with much higher quality steam."

We at Ames continually receive letters like this from the enthusiastic users of AMESTEAM GENERATORS. Ames customers are *satisfied* customers. They know that when they buy AMESTEAM GENERATORS, they buy LOWER-COST STEAM!

What's **Your** Steam Problem?

If you need 10 to 600 HP and want the kind of space-saving, trouble-free service enjoyed by satisfied users of AMESTEAM GENERATORS, contact your nearby AMESTEAM Dealer or write for our Catalog.

AMES IRON WORKS INC.
BOX H-29, OSWEGO, N. Y.

AMES IRON WORKS
BOX H-29, OSWEGO, N.Y.

Gentlemen:

Please send me further information on AMESTEAM GENERATORS and name of nearest representative.

NAME .....

COMPANY .....

ADDRESS .....

For more facts circle 244 on Reader Service Card, p 102

Technical briefs

Latest engineering developments for busy power men

22 papers for you on:
LUBRICATION
NUCLEAR POWER
DIESEL ENGINES

How to find noise level before and after installing rotary electrical machinery

Proposed test procedure for noise measurements on rotating electric machinery, *AIEE Working Group on Noise Evaluation of the AIEE Rotating Machinery Committee*

Paper presents test procedure for measuring noise from rotating electrical machinery recommended by the AIEE. Noise measured is airborne under steady-state operating conditions. Paper outlines practical techniques and procedures which can be followed for uniform determination of noise level produced by a single machine in the normal audible frequency range. Procedure does not cover all possible tests nor does it require the making of any tests described.

Paper lists types of tests; instrumentation; environmental conditions, their effect and how to handle them; methods of finding room constants for rooms of different types, sizes and ambient conditions; general procedures for making tests; analysis and reporting of tests; and the interpretation of results. *AIEE paper 58-1218*

How to specify the noise rating of large electric rotating machines, *M E Talaat, Elliott Co*

This paper attacks noise problem from the viewpoint of someone who knows a machine will be placed in a certain building, and wonders how to calculate the tolerable noise level. He gives values (both average and range) that are known human reactions to given noise levels both in the plant and the surrounding community. In calculating what the noise level will be consideration is given to building construction materials, building size, location relative to other buildings and homes, and the place in the building where operators normally will stand.

Method presented is based on power level rather than the old specification of noise level based on pressure level. A relationship is given so the two can be correlated. *AIEE paper 58-1179*

EDITOR'S NOTE: *See* POWER, *Dec 1958, p 122 for ways to reduce noise in your rotating electrical machinery if the level is too high.*

Lubrication

A surface effect associated with the use of oils containing zinc dialkyl dithiophosphate, *P A Bennett, research staff, General Motors Corporation*

Operation of engines on crankcase oils containing commercial zinc dialkyl dithiophosphate additives can increase the small scale roughness of the lifter foot surfaces. Also, the roughness decreases when oils without the additive are used. Change in roughness coincides with a change in reflectivity that can be detected by eye. There is a rapid increase in roughness when the additive is used and it's maintained at high contact loads, although some smoothing of the roughness was found at high loads.

Results indicate roughness comes from a chemical reaction of the additive with the metal, although what happens is not understood. *ASLE paper 58 LC-11*

Oscillating journal bearing oil film study, *G G Nelson and K Gatcombe, U.S. Naval Postgraduate School, Monterey, California*

Hydrodynamic and boundary films in an oscillating journal-bearing were investigated experimentally by (1) strain-gage torque measuring and (2) electrical resistance through the oil film. By placing a heavy constant load on the bearing and running it over a wide speed range you can create boundary conditions at the ends of the oscillating stroke. Also, at the higher speeds fluid conditions might exist for the whole cycle. You can change conditions simply by changing the oil pressure.

Since results show film thickness can vary almost instantaneously this confirms that time is important in the behavior of these films. *ASME paper 58-A-156*

Surface finish and clearance effects on journal bearing load capacity and friction, *F W Ocvirk and G B DuBois, Cornell University*

Curves based on experimental work compare: (1) load capacity versus minimum film thickness (2) diametral clearance and load capacity (3) friction versus clearance. These curves help clarify the effect of film thickness and clearance ratio on the performance of plain journal bearings. *ASME paper 58-A-134*

The measurement of oil-film thickness in gear teeth, *I O MacConochie and A Cameron, Imperial College, London, England*

Voltage drop across thin oil films measures film thickness between loaded and running gear teeth. Thickness at the pitch line varies from 1 to 4 x 10^{-4} inches, with a slight effect from viscosity and strong effect from load. Thickness at the teeth tips is dependent on the tip relief. Current used in the

experiment is a constant 1 amp, and voltage drop gives the film thickness. The experimental values obtained agree in magnitude with theoretical work done in this area. *ASME paper 58-A-142*

The effects of high energy ionizing radiation on turbine oil performance characteristics, *C F Kottcamp, R P Nejak, Gulf Research and Development Co, and R T Kern, Gulf Oil Corp*
Turbine oils and components were subjected to electron radiation changes in characteristics noted. Results show (1) turbine oil viscosity increased (2) oxidation stability decreased (3) foaming susceptibility increased, but not critically (4) water separation tendencies remained good (5) rust prevention ability decreased (6) wear properties decreased, when turbine oils were exposed to radiation. *ASLE paper 58-LC-2*

Viscoelastic behavior of greases, *E O Forster and J J Kolfenbach, Esso Research and Engineering Co*
Behavior of a mixed soap and a complex soap grease is described under cyclic shear stresses resulting in cyclic deformations. Results indicate greases are viscoelastic bodies, and their response to shear stresses is very time dependent. There are three relaxation mechanisms which correspond to different displacement types occurring within greases. Results support theory that greases are made of a three-dimensional soap fiber network in which oil is immobilized. *ASLE paper 58 LC-3*

The effect of turbulence on slider-bearing lubrication, *Y T Chou and E Saibel, Carnegie Institute of Technology and Rensselaer Polytechnic Institute*
The pressure equation for turbulent flow, based on Prandtl's mixing-length mechanism, in slider-bearing lubrication is derived. Results show that the turbulent effect increases pressure and load carrying capacity, but power loss also goes up. *ASME paper 58-A-30*

Development of radiation resistant oils, *J G Carroll and R O Bolt, California Research Corporation*
Lubricants in three viscosity grades were made with alkylbenzenes containing selected polymers and additives. Results show most conventional oils were damaged beyond usefulness at 10×10^8 roentgens but that the alkylbenzene oils retained lubricating qualities after 50 to 70×10^8 roentgens, and remained fluid well above 100×10^8 roentgens. Results prove feasibility of making radiation resistant lubricants with this new approach. *ASLE paper 58 LC-1*

The conduction of current in bearings, *H N Kaufman and J Boyd, Westinghouse Research Lab*
Paper presents results of investigation made to get a better understanding of problems concerning current conduction through bearings.

Results indicate wear rate is affected by voltage, circuit resistance and oil-film thickness. Large currents can be carried through a zero film thickness with little damage. Once a thickness is established, there is a damage threshold for each thickness.

Wear from bearing currents can be cut three ways: (1) cut voltage supply (2) raise circuit resistance (3) change film thickness so current won't pass at all or reduce thickness to near zero. *ASLE paper 58 LC-10*

Nuclear power

Organic moderated reactors for central station power, *W E Parkins and E F Weisner, Atomics International, Div of North American Aviation, Inc*
Paper gives details of a power reactor, using an organic fluid as moderator and coolant. Located at the National Reactor Testing Station near Idaho Falls, Idaho, the reactor was designed to produce 16-mw thermal power with no provision for generating electrical power. Organic fluid used was Santowax-OM, a commercial mixture of ortho- and meta-terphenyls and some diphenyl. Results of the Idaho installation are given as well as details of this type reactor going in at Piqua, Ohio. *AIEE paper 58-1272*

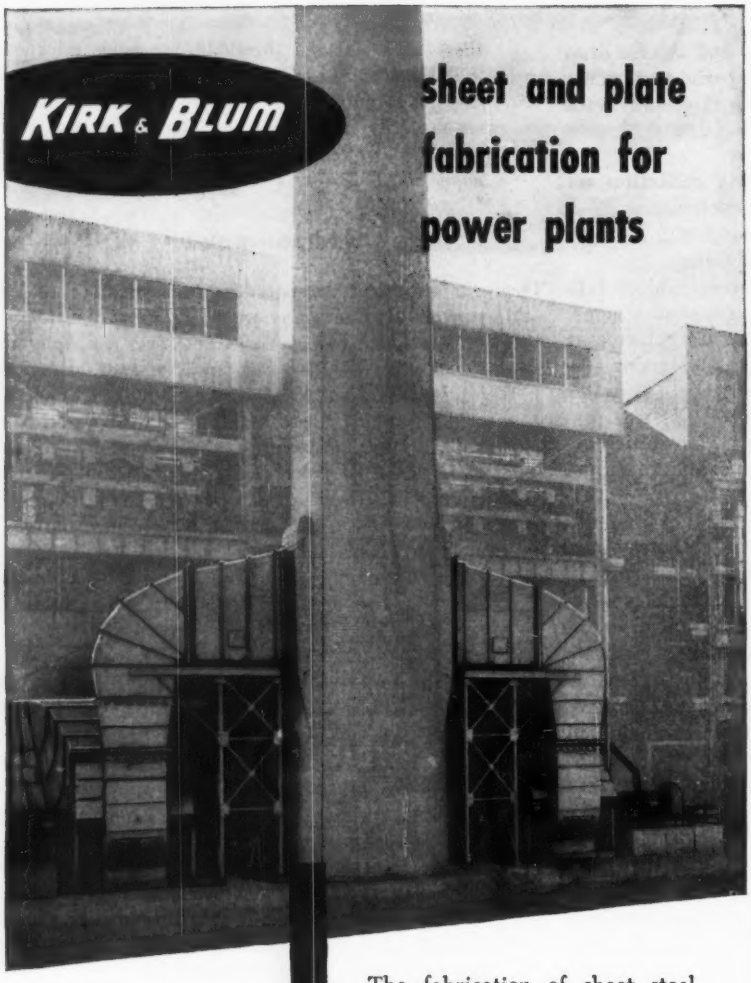
Electrical and control features of the Shippingport atomic power station, *H Frus, H Thompson, H A Van Wassen and E J Woolever, Duquesne Light Co*
Paper describes electrical auxiliary and control systems at Shippingport and tells how they differ from fossil-fuel stations. A closed-circuit transfer station service bus arrangement provides the reliability and flexibility needed here. To date operation at Shippingport has proved simpler than an equivalent coal-fired plant. Also, the reactor auxiliaries and controls power demands are higher than a normal coal-fired plant. *AIEE paper 58-1199*

Performance of the sodium reactor experiment, *J E Owens, W T Morgan and L E Glasgow, Atomics International, Div of North American Aviation, Inc*
Performance of the SRE so far indicates sodium-cooled reactors are technically feasible and the sodium-graphite approach to economic nuclear power is promising. Paper gives extended coverage to what has happened during operation. *AIEE paper CP 58-1273*

Training simulator for nuclear power plant reactor operators, *N E Bush, Westinghouse Electric Corp*
A nuclear power plant simulator has several advantages: (1) Trainees don't have to travel to a distant point for study. (2) Reactor installation is not imperiled because of trainees' errors. (3) Exact duplication of instrumentation and controls mounted on the console mockup gives the operator the "feel" of various reactor system operating procedures. (4) Changes in plant system and instrumentation can be checked out on the simulator before being put to use.

A simulator is now designed for use in training personnel of the merchant ship *N S Savannah*. Features of this particular simulator are described. *AIEE paper CP 58-1300*

continued



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Technical briefs

Begins on page 94

Diesel engines

Formation of pressure pulses by exhaust blowdown, *A W Hussmann and W A Pullman, Pennsylvania State University and Diesel Engine Division, English Electric Company, Ltd, Rugby, England*

A pulse generated when a cylinder of gas exhausts into a pipe may be calculated for different operating conditions. Effect of wave motion generated by the blowdown pulse upon airflow through a cylinder is shown by means of scavenge air flows and indicator diagrams.

The analytical case covers subsonic discharge with wave motion in the manifold, and equations can be handled with a digital computer.

Since the energy content of the blowdown pulses can be calculated, the method can be used for evaluating the potentialities of various engine - turbocharger systems. *ASME paper 58-A-145*

A study, using radioactive lubricating oil, of the rate of oil consumption in an operating diesel engine, *M Pobereskin, D N Sunderman, Battelle Memorial Institute, and E J Fithian, Cooper-Bessemer Corp*

Six experiments on lubricating oil consumption were run on a Cooper-Bessemer FW-6-T diesel engine, using radioactive oil. Results showed: (1) Consumption rate didn't change during 100 hr run-in. (2) Increasing oil temperature and water-jacket temperature decreased consumption rate, while upping load and speed increased it. (3) Removing top oil rings upped consumption noticeably. (4) Tracer method of finding consumption rates as a function of operating conditions is practical. (5) Early wear seems to be entirely independent of oil consumption, since no correlation could be established between wear and consumption rates. *ASME paper 58-A-143*

A radiotracer counting method for engine wear determination, *E H Okrent and G A Weisgerber, Esso Research and Engineering Company*

Authors discuss problems associated

Directions for ordering papers on page 100

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Technical briefs

Begins on page 94

with counting the wear debris from engine tests, using irradiated engine parts which contain multiple gamma activities. They recommended a differential counting technique using a gamma-ray scintillation spectrometer to count the 1.1-mev photopeak of Fe^{59}. Technique was applied successfully to finding wear in a hardenable cast-iron valve train. Using technique, you can get a wear *vs* time picture for each test run, analyze the oil, and minimize surface errors. *ASME paper 58-A-247*

Suppression of engine-exhaust noise, *R Kamo, Armour Research Foundation, The Illinois Institute of Technology*

Low-pass acoustic filters, designed by harmonic analysis of periodic engine-exhaust pressure variation, are possible noise suppressors.

By assuming sound coming from the exhaust pipe opening is the same as a simple source spherical radiator, sound intensity can be calculated. Thus you can predict accurately the frequency spectrum and noise intensity of exhaust pipe end noise for any i-c engine.

A single cylinder, 2-cycle gasoline engine is used for analysis and cut-off frequency calculation is indicated. Principle can be extended to intake silencers as well as exhaust mufflers. *ASME paper 58-A-144*

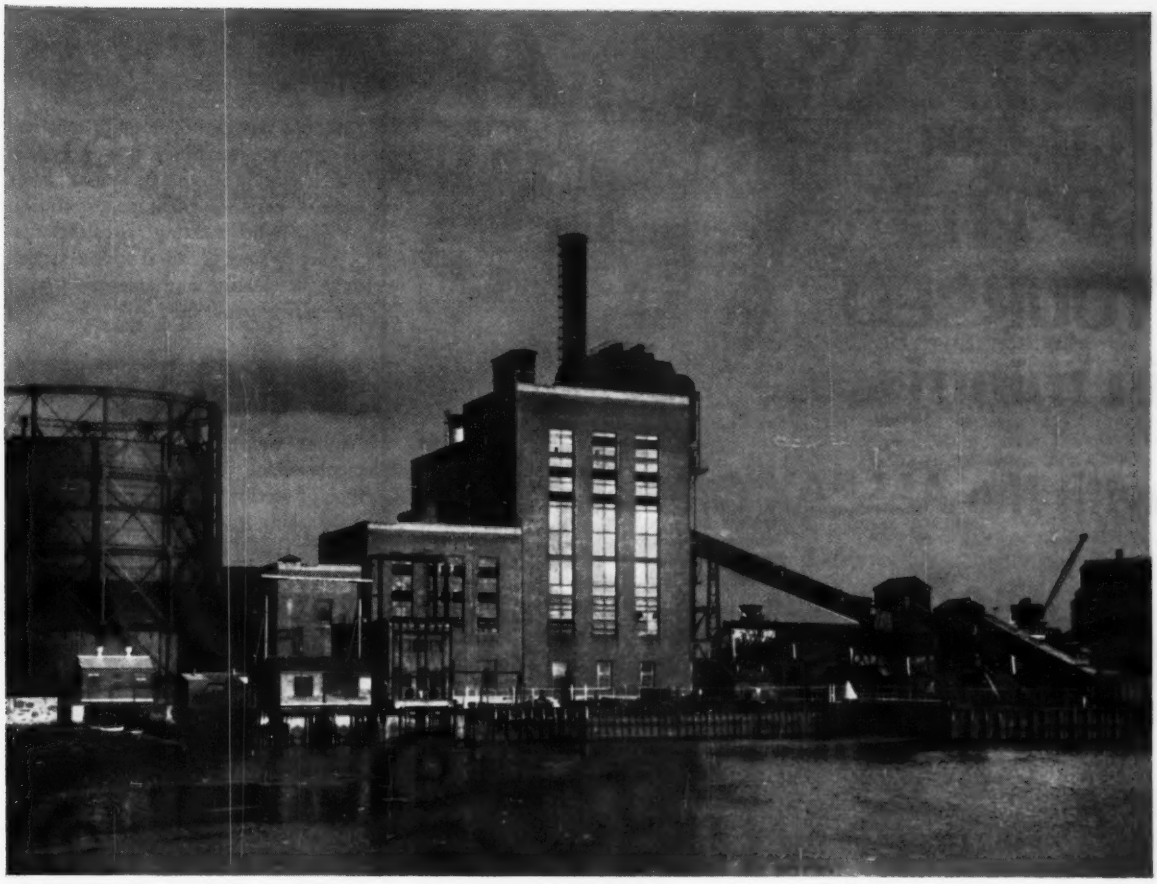
Auxiliary power

Auxiliary power for the Eddystone station, *J A Adams, Philadelphia Electric Company*

Two 325,000-kw turbine-generator units are now being installed at the Eddystone station. Steam-turbine-driven boiler-feed pumps will cut the electrical part of the auxiliary power to about the normal percent, offsetting the greater power needed for higher-pressure units.

Primary objective of the electrical system is to get adequate reliability economically. Layout is simple, with a minimum of cross ties and an absence of complicated throwover schemes. In addition, the electrical system has been coordinated with mechanical requirements to get a

Directions for ordering papers on page 100



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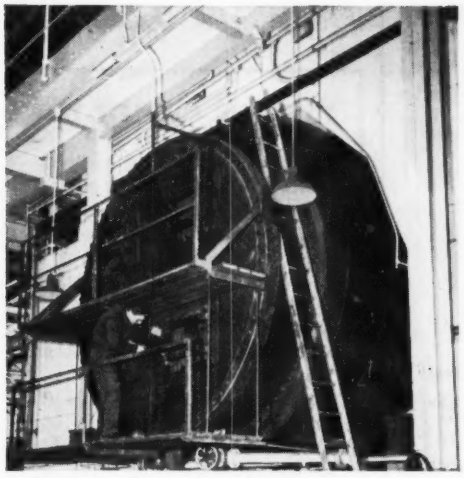

Condenser for main turbogenerator in which Bridgeport tubes maintain a record of high efficiency and long life.

This steam condenser tube record at a New England utility isn't often equaled. The 25,000 sq. ft. condenser in this plant contains 4,340 18-gauge Bridgeport Aluminum Brass tubes, each 22 ft. by 2$\frac{7}{32}$ in. In 17 years of operation only five tubes have had to be replaced.

The plant serves 100,000 people, generating a total of 65,000 kw. The condenser uses harbor salt water, filtered through half-inch mesh screening with chlorine added for slime control. The harbor water has a high ammonia content.

Tubes are Aluminum Brass—77% copper, 2% aluminum and 21% zinc—a *standard* Bridgeport alloy that, in this case, is giving *exceptional* service.

Making the exception the rule is an everyday occurrence at Bridgeport. Technical Service, research, and manufacturing techniques and facilities—all are aimed at duplicating stories like this in condenser and heat exchanger operation.

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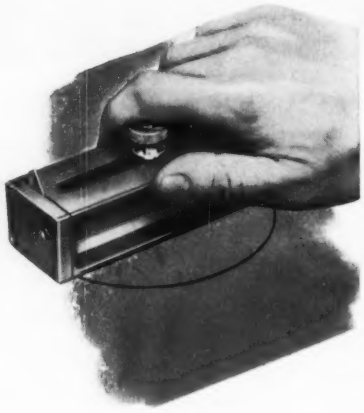

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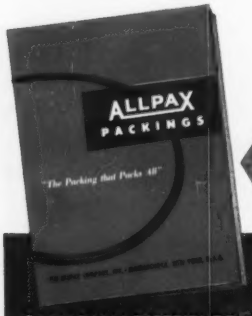

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Technical briefs

Begins on page 94

balanced design. Each main unit has its separate auxiliary power system and a station auxiliary system takes care of common plant needs, station services and starting requirements.

Each system is radial with 4-kv ties only for starting and emergency supply. *AIEE paper 58-1107*

Auxiliary power systems for nuclear plants, *R E Frick, Gilbert Associates*

Author points out design requirements which will effect quantity and type of auxiliary power supply equipment going into nuclear plants. *AIEE paper CP-58-1299*

Transformers

Measurement of iron and copper losses in transformers, *T R Specht, L B Rademacher and H R Moore, Westinghouse Electric Corp*

It is highly desirable to improve the accuracy of measurement of the iron and copper losses of transformers. Unless accurate measurements of the watt loss are available, it is difficult to evaluate the benefit of modifications in processes and constructions intended to reduce losses.

This paper discusses methods for improving the accuracy of measurement of iron losses and of copper losses at low power factor. *AIEE paper, No. 58-158*

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from the following sources unless otherwise stated. Order complete paper from source, not POWER.

American Society of Lubrication Engineers. Identified by the initials ASLE and available from ASLE, 84 Randolph St, Chicago 1, Ill.

American Society of Mechanical Engineers. Identified by initials ASME and obtainable through ASME, 29 W 39th St, New York 18, N. Y.

American Institute of Electrical Engineers. Identified by initials AIEE and obtainable t hrough AIEE, 33 W 39th St, New York 18, New York.

New free literature

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AIR CONDITIONING, HEATING AND VENTILATION

101 **Heating,** ventilating units are covered in 20-p bulletin 910. Filter, coil, fan-capacity data is given for 600- to 73,000-cfm units. American Air Filter Company, Inc

102 **Dust-collector** application handbook, 24 pp, describes range of industrial dust- and fume-producing processes, proper collectors to control them. Wheelabrator Corporation

103 **Cloth-filter** dust collectors are subject of two spec sheets. Rating tables are given for 500-cfm units. Torit Manufacturing Co

104 **Cooling-system** winter layup is described in 2-p bulletin. Lists correct procedures to follow. Water Service Laboratories, Inc

105 **Dampers** and damper operators are listed in new catalog C101-3. Minneapolis - Honeywell Regulator Co, Industrial Div

106 **High-efficiency filters** are discussed in 8-p bulletin 238. Media and full assemblies are illustrated. American Air Filter Co

107 **Solid - polyurethane** applications are described in a recent 8-p ASME paper. Uses include pump stators, LOX containers, seals. Disogrin Industries, Inc

108 **Carbon-graphite** composition, qualities and applications are covered in 8-p brochure. Mechanical, thermal and chemical uses are included. The Ohio Carbon Company

109 **Fluorocarbon plastic** with exceptional properties is discussed in 4-p bulletin. Info on chemical structure, chemical, electrical and mechanical properties is given. Fluoro-Plastics, Inc

110 **Aluminum** use in electrical-power generating stations is theme of 34-p brochure. Applications range from bus conductors, siding, ducts, to stair treads, condenser tubes. Aluminum Company of America

111 **Magnetic circuits** are discussed in 12-p Sept issue of "Applied Magnetics." Various uses for permanent magnets are described. The Indiana Steel Products Company

112 **Cast-iron brazing** is topic of 4-p bulletin 80. Advantages, characteristics are listed. Handy & Harman

MATERIALS HANDLING

113 **Cradle idler** and belt conveyor is described in 8-p bulletin 458. Photos, dimensional drawings and capacity tables are included. McNally Pittsburg Mfg Corp

114 **Bucket elevator** is subject of 2-p spec sheet. Units are available with belt- or chain-mounted buckets. The Bucket Elevator Company

115 **Bin device** to speed coal, other bulk discharge is covered in 4-p bulletin BD958. Unit delivers up to 7000 lb per min. Fairmont Machinery Company

ELECTRICAL GENERATION, TRANSFORMATION, CONVERSION

116 **Synchronous generators** are topic of 2-p bulletin 2100-PRD-251.

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101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125
126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150
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Units come in 50 through 187 kva, 60 or 50 cycles. Electric Machinery Mfg Company

117 **Rectifier equipments,** pumpless mercury-arc type, are discussed in 12-p bulletin GEA-6849. Photos, line drawings, power-cost curves included. General Electric Company

ELECTRICAL DISTRIBUTION AND PROTECTION

118 **Selection guide** for molded-case breakers, enclosures is an 8-p folder. Master selection chart groups units by types, current ratings. I-T-E Circuit Breaker Company

119 **Heavy-duty limit switches** are topic of 16-p catalog 84. Drawings, photos, diagrams are included. Minneapolis - Honeywell Regulator Co, Micro Switch Div

120 **Mercury switches** as direct delaying elements are discussed in 1-p spec sheet. American Designed Components, Inc

121 **Metalclad switchgear,** 4160 - v units, are covered in 24-p bulletin 2804-1A. Indoor, standard and walk-in outdoor types are included. I-T-E Circuit Breaker Company

ELECTRICAL APPLICATIONS

122 **Dripproof pancake motor** is described in 4-p bulletin 2150. Full engineering info is given; photos, cutaways and specs are included. The Louis Allis Co

123 **Vaportight** lighting-fixture line is topic of 12-p catalog. Specs, dimensional data with outline drawings are included. Stonco Electric Products Company

124 **Submersible** wet-winding motors are covered in 2-p bulletin GEA-6883. Cutaway diagram, rating chart and dimensions are provided. General Electric Company

125 **Air motors** from 0.3 to 24 hp, speeds from 50 to 2580 rpm, are topic of 16-p bulletin 5072A. Case histories, cutaway photos, power curves give details. Ingersoll-Rand Co

HEAT EXCHANGE

126 **Hot - water heating** convertors are described in 12-p bulletin 303-A. Construction data are given. Patterson-Kelley Co, Inc

127 **Chilled-water cooling** coils are covered in 2-p spec sheet CWC-200. Charts give complete rating data for central and zone air-conditioning systems. Halstead & Mitchell

INSTRUMENTATION

128 **Pneumatic** temperature controls are discussed in 4-p folder, with application pix included. Partlow Corporation

129 **Thermocouples** and accessories are covered in 36-p catalog and price list. Photos illustrate units. Claud S Gordon Company

130 **Precision** pressure gages are listed in 36-p booklet DH-65. Photos, tables are included, plus engineering info, recommended uses. American Chain & Cable Company, Inc, Helicoid Gage Div

131 **Thermatron** for analysis of one component in a complex gas mixture is described in 4-p bulletin 0716-2. Specs, typical schematic wiring diagrams are included. Mine Safety Appliances Company

132 **Centralized control** systems are illustrated and described in 16-p

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bulletin 106. Design approach, materials, construction are shown. Panellit, Inc

133 **Digital voltmeter**—operation, circuitry, specs—is topic of bulletin 3018. All solid-state device uses comparison technique. Beckman Systems Division

134 **Digital voltmeter** with built-in ac converter is discussed in 2-p bulletin 402. Includes circuit diagram. Cohu Electronics, Kin Tel Div

135 **Digital voltmeter** with 5-digit display is subject of 2-p spec sheet 501. Cohu Electronics, Kin Tel Div

136 **Vibration meter** is shown in 2-p spec sheet WK-B-781A. Features, specs are listed. Wayne Kerr Corporation

137 **Temperature indicator** monitor is described in 4-p bulletin MSP-155. Switching, amplifying, off-normal alarms are discussed. Hagan Chemicals & Controls, Inc, Kybernetes Div

138 **"Automatic controls systems** guide for architects and engineers" is title of 8-p booklet F-8944. Analyzes application, basic types, selection factors. Barber-Coleman Company

139 **Panel control systems** for automatic oil, gas or dual-fuel burners in boiler installations are described in 4-p bulletin 5803-A. Iron Fireman Manufacturing Company

140 **Data loggers** for weight, strain, force, flow, pressure or temperature are covered in 4-p brochure. Gilmore Industries, Inc

141 **Accessories** for control-panel info systems are covered in 4-p bulletin 104. Panellit, Inc

WELDING

142 **Wall chart** of 89 problem-solving specialty welding alloys and fluxes is 18x22 in. Maintenance, production and installation jobs are covered. All-State Welding Alloys Co, Inc

143 **Wire-comparison chart** is included in 4-p folder DH-1218-0. Physical properties are detailed. American Chain & Cable Company, Inc, Page Steel and Wire Div

144 **Ground-current conduction** for welding positioners is explained in 14-p booklet. Photos, diagrams illustrate text. Aronson Machine Company

145 **Electrodes** for special purposes—hardsurfacing and welding stainless steel—are listed in 20-p catalog 7000-2. The Lincoln Electric Company

146 **Welding fittings** and flanges are discussed in 54-p catalog TT600. Stainless-steel welding procedures are described. Chemetron Corporation, Tube Turns Div

147 **Submerged-arc** tandem welding is topic of 4-p bulletin 5200.2. Includes photos, diagrams. The Lincoln Electric Company

148 **Welding fittings** and flanges are subject of 4-p technical bulletin FDC-259. Specs are given for 3-in. nominal pipe sizes. The Babcock & Wilcox Company

149 **"Introduction** to manual heliarc welding" is title of 8-min 16-mm sound and color movie. This orientation film may be borrowed free of charge. Linde Company

MAINTENANCE

150 **Fireproofing** that can be applied by machine is discussed in bul-

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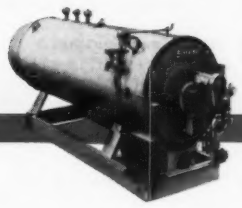
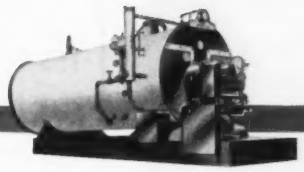


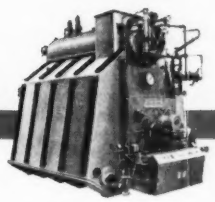
TYPE "C"

Horizontal four-pass fire tube packaged boiler for installations where space is limited. Capacities from 20 to 350 bhp. Fully automatic, burning oil, gas or both. Equipped with dependable Superior Rotary Burners and induced draft. Pressures to 250 psi. or for hot water operation. Write for Bulletin 1000C.

TYPE "F"



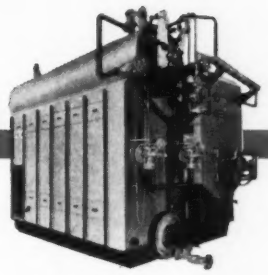
Horizontal four-pass fire tube Type "F" units are fully automatic, burning oil, gas or both. Capacities from 20 to 600 bhp. Pressures to 250 psi. or for hot water. Built-in induced draft for clean, quiet operation. Write for Bulletin 1000F.



TYPE "AS"

Completely packaged water tube boilers for steam capacities as low as 4000 lbs. of steam per hr. Fully automatic, burning oil or gas or both. Design pressure 190 psig. Rear-mounted mechanical draft fan, air-cooled furnace floor and firing front. Maximum capacity 13,000 lbs. of steam per hr. Write for Bulletin 1000S.

TYPE "D"



Completely packaged water tube boilers for capacities from 8,000 to 60,000 lbs. of steam per hr. Wide selection of burner and control arrangements. High, rear-mounted mechanical draft fan for quiet operation; uncluttered firing front. Write for Bulletin 1000D.

YOU'LL GET AN UNBIASED ANSWER FROM: SUPERIOR

Make your selection from the line that includes so many different models for capacities as low as 20 bhp., and as high as 60,000 lbs. of steam per hour. Water-Tube units, Fire-Tube units. Units that burn light oil, heavy oil, and gas.

Only Superior Combustion Industries makes them all as complete packages giving you and your consulting engineer freedom to choose a unit which closely meets the requirements of your installation.

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Specialists in PACKAGED BOILERS... exclusively

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TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

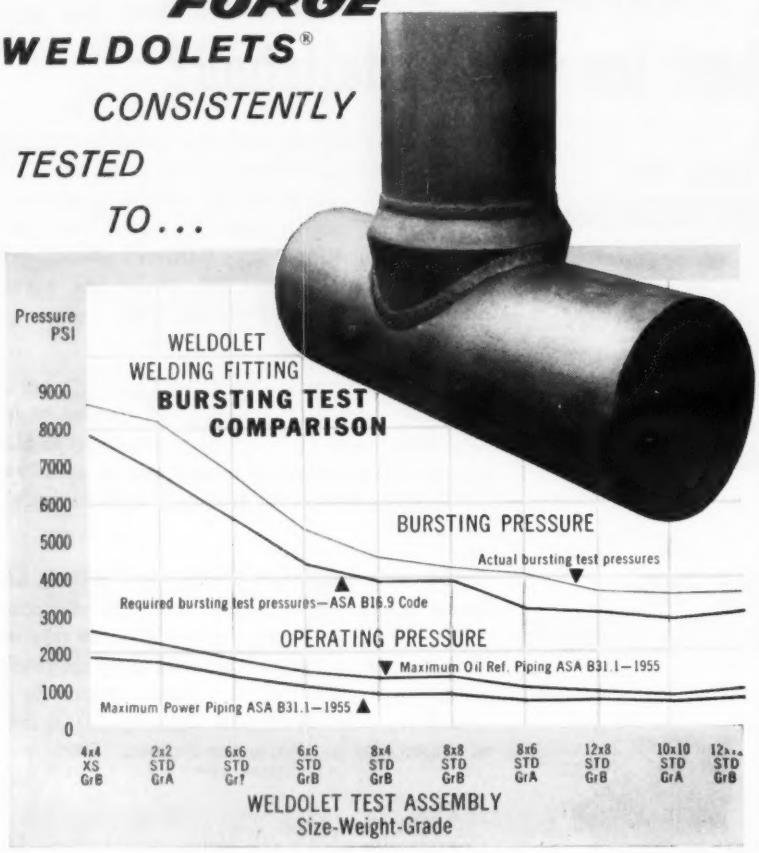
SUPERIOR PACKAGED BOILERS

For more facts circle 250 on Reader Service Card, p 102

BONNEY FORGE

WELDOLETS®

CONSISTENTLY TESTED TO...



...OVER 4½ TIMES MAX. OPERATING PRESSURE

"Shape of Reinforcement"—has been pioneered by Bonney for the past 20 years. The fact that shape is as important and even more important than area replacement for branch reinforcement is now gaining wide industry recognition. Even though Weldolets *do* have sufficient area replacement, the factor setting them apart from conventional lap type reinforcement is their SHAPE . . . Reinforcement close to the juncture—completely bonded homogeneous reinforcement avoiding cracks, fillet welds, and re-entrant corners—reinforcement tapering at the sides to prevent abrupt change in thickness where fitting joins header pipe.

Recent design improvements in the Weldolet line, based on extensive stress analysis tests, provide all these desirable "shape" factors. Specify and use Weldolets for all your full size and reducing branch connections. They are available in carbon steel and all alloys for any piping service.

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CARBON STEEL
STAINLESS
ALLOY
for all services

BONNEY FORGE and TOOL WORKS
ALLENTOWN, PENNSYLVANIA

Free literature

Begins on page 101

letin F-10. Ratings, application data are given. Columbia Acoustics and Fireproofing Company

151 **Trouble-shooting** a motor control, preventing refrigerating-plant failures are topics of 12-p reprint. Diagrams, installation photos illustrate text. The Ideal Electric & Manufacturing Co

152 **Boiler cleaning** is described in 4-p bulletin. On-the-job photos help tell the story. Breuer Electric Mfg Co

153 **Ultrasonic cleaner** with 70-gal capacity is topic of 2-p data sheet. The Narda Ultrasonics Corporation

154 **Touch-up lacquer** for control panelboards is topic of 1-p data sheet. Panellit, Inc

NUCLEAR ENERGY

155 **New devices** for remotely handling radioactive, toxic or highly flammable materials are described in 20-p booklet. Drawings and photos included. General Mills, Inc, Mechanical Div

156 **Radiation-resistant fluids,** polyphenyl compounds and their alkyl derivatives, are listed in 4-p booklet. Monsanto Chemical Company

157 **Engineering services,** capabilities of company are described in 8-p brochure. Sylvania-Corning Nuclear Corp

158 **Engineering research** and development facilities are covered in 16-p brochure. Alco Products, Inc

159 **Magnetic amplifier** systems for nuclear-reactor installations are subject of 8-p brochure S-963. Functional diagram outlines one system. Magnetic Amplifiers, Inc

160 **Nuclear graphite** is topic of 8-p bulletin. Tabular data, application photos show graphite as a moderator, neutron reflector, thermal column or subcritical pile. National Carbon Company

161 **Nuclear pumps,** in liquid-metal, liner-motor and mechanically sealed types, are covered in 4-p bulletin. Byron Jackson Pumps, Inc

162 **"Nuclear fuels:** Key to reactor performance" is title of 24-p booklet. Design aspects, fuel cycle, typical reactors and company's services are some topics covered. Sylvania-Corning Nuclear Corp

MECHANICAL POWER TRANSMISSION

163 **All-synthetic belting** for modern drives is described in 6-p folder.

continued

SLUDGE *situation gets a clean-up*

STANODIESEL Oil M helps keep diesels clean and running smoothly at Princeton, Missouri

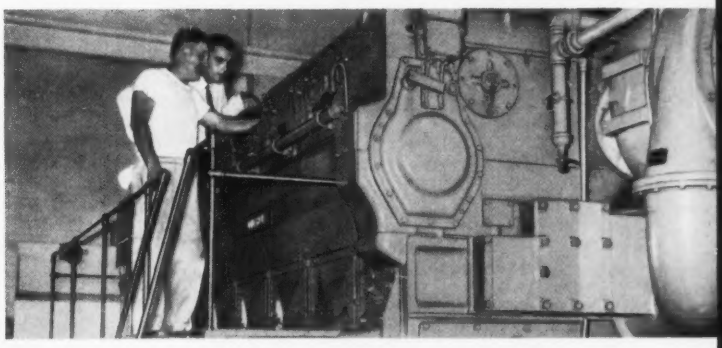
The situation: Consumer Public Service Company, Princeton, Missouri, has three diesels in service—a 225 hp unit installed in 1951, a 1,083 hp unit installed in 1954 and a 1,440 hp unit installed in 1956. In previous equipment, sludging had been a problem, so when these units went into service, a heavy duty oil was recommended—STANODIESEL Oil M.

What has happened: The oil has been inspected regularly by a Standard Oil lubrication specialist. Samples are periodically removed for analysis at Standard's Whiting Indiana research laboratory. Analysis shows the oil to be in excellent condition. Since the 1,440 hp unit was started up in 1956, it has generated 1,672,200 kw hours of electricity.

What you can do: Find out more about how STANODIESEL Oil M can deliver service in your plant. Ask for more information from the Standard Oil lubrication specialist near you in any of the 15 Midwest or Rocky Mountain states. Or write **Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.**

Quick facts about
STANODIESEL Oil M

- Keeps crankcase, pistons, cylinder walls clean.
- Combats deposit and wear problems imposed by use of economy fuels.
- Maintains film on difficult-to-lubricate parts.
- Eliminates fuel injector and pump sticking caused by deposits on injector barrel and plunger where fuel and lube oil mix.



Darrel McCormick, Standard Oil lubrication specialist and William Rutledge, plant superintendent, inspect 1,440 hp diesel in Princeton, Missouri plant. Darrel is an experienced hand at this work. He has an engineering degree from Vanderbilt University plus four years' experience in industrial lubrication work at Standard Oil. He has also completed the Standard Oil Sales Engineering School.

You expect more from **STANDARD** *and you get it!*

For more facts circle 252 on Reader Service Card, p 102

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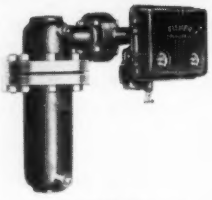
Type 657-A with 3500 positioner

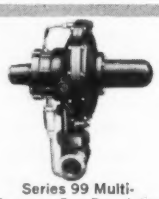
Type 4150 and 4160 Wizard II Pressure Controllers



Series 2500-249 and 2500-259B Level-Trols

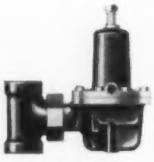
Type 95-H Pressure Reducing Valve

Type 630 "Big Joe" Field Regulator

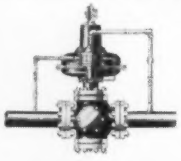


Series 99 Multi-Purpose Gas Regulators

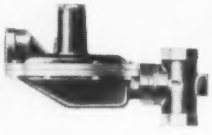
Type 655-A Pressure Regulator



Series 620 and 621 Farm Tap Regulators

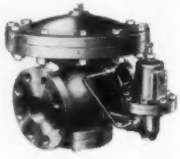


Series 298T Gas Regulators



Series S100 and 730 Service Regulators

Series 67FR Combination Filter-Regulator



Type 92B Pilot Operated Steam Reducing Valve

This "supermarket" availability of Fisher Control Valves and Controllers makes your delivery problems a thing of the past. Fisher keeps a stock of the equipment at left always on hand ready to ship to you at hourly notice. This means emergency requirements are met without costly delivery delays. This stock of control equipment includes all the most popular types in standard sizes.

In addition to the large factory stock, the Fisher offices in the column to the right which are starred carry a big selection of Fisher equipment in inventory to assist you.

Fisher constantly reviews the stock carried in the Supermarket and adds new items from time to time when your needs indicate.

Phone, wire or TWX (Marshalltown 578 or 579) and Fisher will have your order en route in a matter of hours, Saturday and Sunday excepted.

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FISHER GOVERNOR COMPANY

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CONTINENTAL EQUIPMENT CO. DIVISION, Coraopolis, Pennsylvania

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*WICHITA–LIBERAL
Sullivan-Mears Company
WINNIPEG
Mechanical Valve & Engineering Spec.

Free literature

Begins on page 101

Advantages, hp ratings, correction factors are listed. J E Rhoads & Sons

164 **Speed reducers** in sizes up to 40 hp are covered in 4-p bulletin 20B9053. Photos, drawings are included. Allis-Chalmers Manufacturing Company

PUMPS

165 **Motor pumps** in 20 sizes for off-the-shelf delivery are described in 8-p bulletin 70022. Dimension diagrams, tables are included. Ingersoll-Rand Company

166 **Mechanical seals** for all centrifugal pumps are listed in 4-p bulletin. Borg-Warner Corporation

167 **Cryogenic-service** pumps are discussed in 4-p folder F-1251. Performance is detailed, specs listed for turbine type and immersed-reciprocating pumps. Linde Co

168 **Proportioning pumps** are listed in catalog 100. Info is also given on pump-tank chemical-feed package system. American Meter Company, Pump Div

STEAM GENERATION

169 **Packaged boiler** with water-cooled rear combustion chamber is topic of 4-p bulletin 200. Photos, specs and dimensional data included. Johnston Brothers, Inc

170 **Fuel-burning system** is topic of 8-p 4-color bulletin 1255. Oil, gas and combination burners are listed. Cutaway views show operation principles. Orr & Sembower, Inc

171 **Vortex burners** in six standard models are detailed in 4-p bulletin 116. Photos demonstrate short-flame characteristic. Thermal Research & Engineering Corp

172 **Packaged steam generators** in 18 sizes are shown in 6-p folder. Spec sheets on ten sizes of hot-water generators are also included. National-U.S. Radiator Corporation, Cyclotherm Div

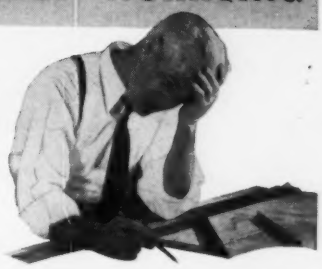
173 **Boiler guide** for engineers is a 20-p pamphlet with over 30 illustrations and graphs. Costs, fuel, space, burner efficiency are some topics covered. Cleaver-Brooks Company

174 **Boiler company** — background, growth, facilities — is described in 8-p brochure. Missouri Boiler and Tank Company

VALVES, PIPING, FITTINGS AND SPECIALTIES

175 **Stainless-steel valves** for corrosive services are listed in bulletin 7. Design details are given

STOP WORRYING



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. . . with a complete line of all types and sizes of flexible metallic tubing . . . plus "Flexineering." That well-known technical help of Penflex engineers on your specific design, application and installation . . . plus the "know-how" to supply just the right flexible tubing you need.

Whether you need steel, bronze or stainless-steel to convey air, oil, water, gas, steam, volatiles or light solids, Penflex has the answer. Its complete line of corrugated and interlocked tubing is rugged, safe at high pressures and temperatures. Write for complete data to Pennsylvania Flexible Metallic Tubing Co., Inc., 7237 Powers Lane, Philadelphia 42, Pa.

NEW DATA BOOK FREE
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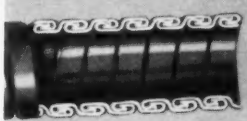
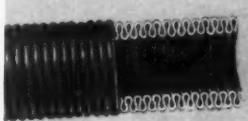


Penflex Interlocked Hose



Penflexweld All-Metal Tubing

PENFLEX
TIGHT AS A PIPE BUT...
FLEXIBLE

circle 254 on Reader Service Card, p 102

Here's POWER to clean tubes from 1/2" to 2" QUICKLY

Rotojet Junior Tube Cleaners are unusually powerful for their size and weight. They are fed easily through the tubes with the operating hose, and can be shifted quickly from tube to tube. Their convenient size, speed, and ease of operation offer a marked contrast with external cleaners costing many times more.

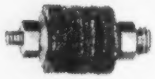
An air valve directly behind the Rotojet motor permits one-man operation. Very little headroom is required, and either vertical or horizontal tubes can be cleaned.

Simplicity of Rotojet design and precision construction assure long service, efficient use of power, and freedom from trouble. Economical brushes, cutters, and scrapers meet practically any requirement.

Send for Bulletin J-410.

Expanding scraper and replaceable element.

Expanding brush and replaceable element.



Sectional wire brush.

Air valve for one-man operation.

ROTOJET®
Junior TUBE CLEANERS

ELLIOTT COMPANY – ROTO PLANT
Tube Cleaner Specialists Since 1910
153 Sussex Avenue, Newark, N. J.

Free literature

Begins on page 101

on 36 basic valves, 40 variations. Alloy Steel Products Co, Inc

176 **Reducing valve** for initial pressures to 300 psi is topic of catalog sheet. Atlas Valve Co

177 **Valve - application** data sheets come in a regular series. No. 1 describes valves for LOX and other cryogenics. Koehler Aircraft Products Co

178 **Stainless-steel valves** in steel-gate, globe and swing - check types are topic of catalog 59 SS. A 10-page section shows degree of resistance of various alloys. Jenkins Bros

179 **Teflon hose** is subject of 6-p folder 400. Construction, assembly and attachment specs are given. Titeflex, Inc

180 **Stainless - steel tubing,** welding fittings and flanges are topic of 8-p bulletin TDC-190. The Babcock & Wilcox Company

181 **Dall flow tubes** for metering water, other fluids are topic of 4-p bulletin 115-LIB. Photos, dimensional and capacity tables, installation diagrams are given. Builders-Providence, Inc

182 **Carbon,** alloy and stainless-steel tubing, pipe, fittings and flanges are listed in 4-p cross-reference folder TDC-186. Correlates type of steel, application and specs. The Babcock & Wilcox Company, Tubular Products Div

183 **Pipeline strainers,** self-cleaning type in ¼- to 3-in. sizes, are described in 2-p bulletin 1210B. Diagrams, specs included. Sarco Company, Inc

184 **Hastelloy valve** casting techniques are described in bulletin 10. Illustrations of important valve designs are included. Alloy Steel Products Company, Inc

185 **High-temperature** properties of Croloy 16-13-3 stainless tubing and fittings are described in 2-p technical data card TDC-189. The Babcock & Wilcox Company, Tubular Products Div

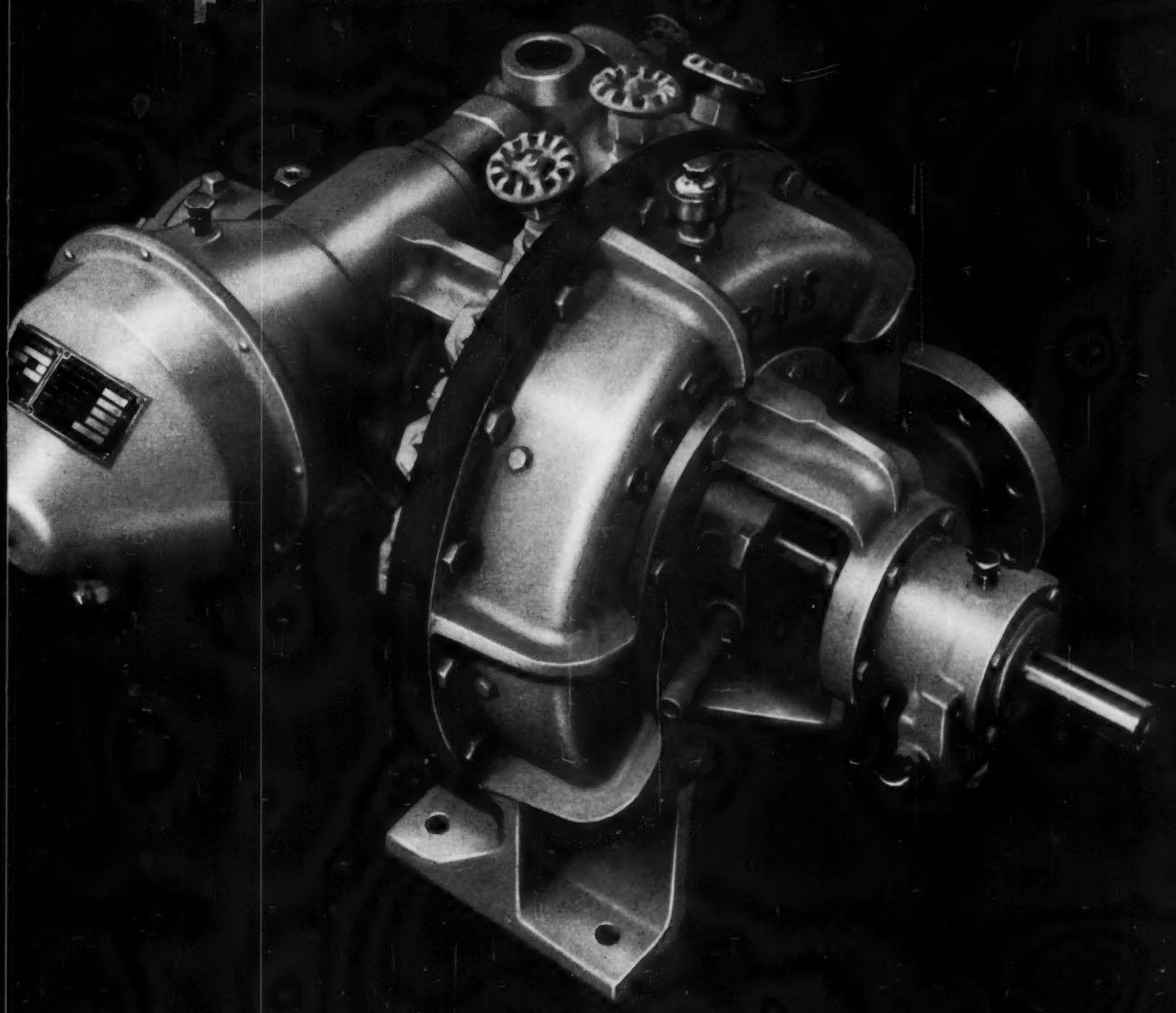
186 **Spray nozzles** for large quantities of liquids at low temperatures are covered in 2-p bulletin 6A-627. Capacity, size, dimensional info is given. Schutte and Koerting Company

187 **Slide selector** for liquid-level gages and valves shows specs, sizes and other data in easy-to-use form. Jerguson Gage & Valve Co

WATER TREATMENT

188 **Chemical processing** is subject of 6-p bulletin WC-120. Lists

COPPUS BLUE RIBBON PRODUCTS



Coppus Horizontal Steam Turbine

NEW RUGGED DESIGN—BLUE RIBBON RELIABILITY! Here's a new dimension in turbine performance! Coppus brings you a new rugged stability of design . . . a new measure of reliability in a complete range of power-packed turbines, from 1 HP to 250 HP — marked with the Blue Ribbon only after each is precision made . . . precision tested. Performance features like these assure you Blue Ribbon Reliability —

A totally enclosed governor . . . totally enclosed, independently operated safety trip . . . easily replaceable packing and bearings . . . multiple steam nozzle control . . . brake rim for added safety . . . wide bucket "L" type wheel (optional) for minimum water rate.

Coppus Turbines are built to customers' specifications, including API and NEMA standards. All Coppus Products carry the same Blue Ribbon assurance of reliable performance. For further facts on turbines, send for new Catalog 200. COPPUS ENGINEERING CORPORATION, 162 Park Avenue, Worcester, Mass. Sales Offices in *Thomas' Register*.

COPPUS
STEAM TURBINES

For more facts circle 256 on Reader Service Card, p 102

I wish we had more personnel and time to prepare this study for a new power plant and site.

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Give your non-routine operations to Pioneer

Design and Consulting Engineering Services. Pioneer has specialized in designing power plants for 57 years. It offers design service for fossil fuel, hydro and atomic plants. It will also assist in forecasting load growth, in site selection, in purchasing and expediting of equipment and in supervising construction. Pioneer's other services include substation, transmission and distribution studies and design.

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NEW!
On your letterhead, write for 40-page booklet, "Pioneering New Horizons in Power". Describes Pioneer's engineering services, and corporate services, from financing to operation.

57 YEARS

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231 SOUTH LA SALLE STREET, CHICAGO 4, ILLINOIS

Free literature

Begins on page 101

latest services available. Graver Water Conditioning Co

189 **Hydrazine product** for boiler feedwater treatment is detailed in 4-p bulletin 589. Specs are given for the nonflammable liquid. Betz Laboratories, Inc

190 **Water conditioning** with ion exchangers is discussed in 60-p handbook A-5. Softening, dealkalizing, demineralizing processes are discussed from standpoint of equipment, chemicals needed and quality of water produced. National Aluminate Corporation

191 **Ultra-pure water** for nuclear plants is discussed in 4-p technical reprint T-162. Reasons for purity needs are covered. Graver Water Conditioning Co

192 **Feedwater-system** spec sheet details a completely automatic generator installation. Charts on pump discharge, boiler pressure and receiver capacity are included. National-U.S. Radiator Corporation, Cyclotherm Div

193 **Plastic data cards,** pocket sized, list water equivalents and estimated requirements for steam generation, refrigeration, cooling. Industrial Chemicals, Inc

194 **Tray** type deaerating heaters are covered in 12-p bulletin WC-106A. Principles of deaeration, tray-heater operation are discussed. Graver Water Conditioning Co

195 **Mixers and mixing** are subject of bulletin 730. Theories are discussed, selection tables given. Infilco Incorporated

★ EDITOR'S NOTE: *The following bulletins may be requested directly from manufacturer. Write on company letterhead to addresses listed below*

★ **Tracing templates** for mechanical system development are offered in free package. Gears, dials, cams, shafts, couplings are some of components covered. PIC Design Corporation, 477 Atlantic Ave, East Rockaway, L. I., N. Y.

★ **Forged-steel** valves, fittings, flanges and unions are covered in 432-p catalog. Book features new types and trims to meet severe fluid and gas-handling duties. Henry Vogt Machine Company, 1000 W Ormsby St, Louisville 10, Ky.

★ **ASME Boiler Code guide** illustrates some types of pressure-vessel construction. Missouri Boiler and Tank Company, 23rd & Papin St, St. Louis 3, Mo.

★ **Precision welding** equipment is covered in 4-p catalog. Vacuum Tube Products Co, 2020 Short St, Oceanside, Calif.

Super 70's "On Stream"

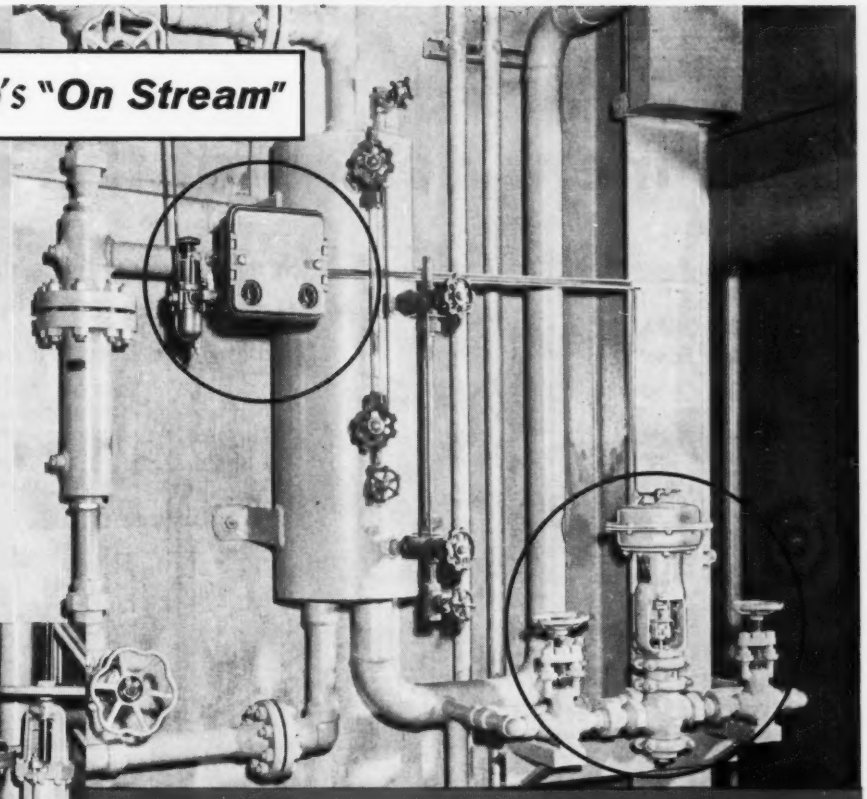


Photo at right shows a turbine gland exhauster level control system with BS&B Level Control and Super 70 Control Valve.

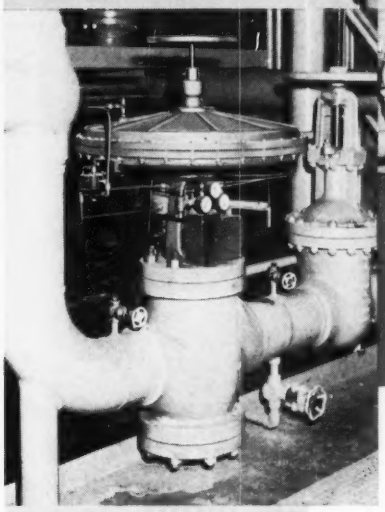


Photo above shows a BS&B pressure-balanced deaerator level control valve, complete with valve positioner, reverse acting relay and booster relays.

BS&B CONTROLS . . .
"On The Job" At Conesville!

Conesville No. 2, one of two new 125,000 KW steam-electric generating units for Columbus and Southern Ohio Electric Company, is now "on the line" at Conesville, Ohio.

BS&B Controls make up an important part of the controls system of this plant, with Super 70 Control Valves installed in Heater Drain, Steam Reducing and Water Supply Services. BS&B Level, Pressure and Temperature Controllers also play an important role in this plant's automatic operation.

Conesville No. 1, a "sister" unit now under construction for C and SOE, is similarly equipped with BS&B Controls and will go into service sometime early this year. BS&B personnel worked closely with the staffs of C and SOE, and Ebasco Services Incorporated, Engineers and Constructors, in the design, application and operation of these control systems.

Next time you have a new station "on the boards," specify BS&B Controls right down the line. They're dependable, efficient, and cut down maintenance costs. You'll get application engineering assistance, too!

SUPER BS&B 70

BLACK, SIVALLS & BRYSON, INC.

Controls Division, Dept. 4-Q2

7500 East 12th Street Kansas City 26, Missouri

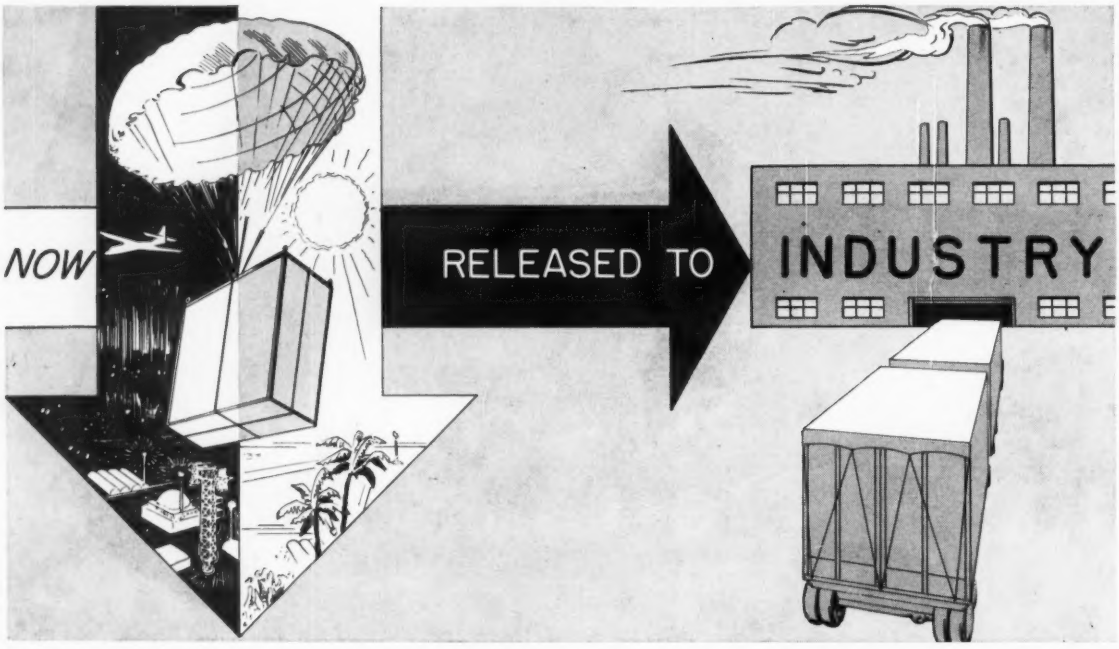
For more facts circle 258 on Reader Service Card, p 102

EXCLUSIVE

Equipment design of the month

On this page each month you will see the wraps taken off a significant new product at least 30 days *before* it's released to any other publication, and before it's advertised anywhere

By STEVE ELONKA
Associate Editor



Two radome cooling units ready for your plant

Now, a packaged self-contained air-conditioner unit and an air-cooled refrigeration unit package, designed for air-force radomes, are ready for your plant. Each unit has three air-conditioning or refrigeration systems. One, two or all three may run at the same time. If one unit develops trouble, the other two keep running. Machine signals its own headaches, so trouble can be spotted by inexperienced help. Glycol, the nonfreeze heat-transfer medium or coolant, travels in a closed circuit, absorbs excess heat. As it flows back to the liquid cooler, heat is transferred to the atmosphere.

Built for the tropics, over salt water or as far north as Distant Early Warning (DEW) Line, key parts are corrosion- and fungus-proof. Designed by Carrier Corp to be dropped by parachute from cargo plane, the units are enclosed in an angle-iron frame.

For industry, you can use them for rough service in mines, oil drilling or nomad operations calling for equipment that can take a beating. They're also adaptable for manufacturing areas having high heat load. Units can be moved by lift trucks without fear of damage.

Air conditioning unit draws in room air with 3-hp centrifugal fan. Return air passes through finned copper cooling coils having face velocity of 450 fpm. Cool, dehumidified air is discharged through ductwork. About 11,000 cfm air is discharged outside. Three 7½-hp hermetic reciprocating compressors, using Freon-12, are connected to three independent refrigeration circuits.

Refrigeration unit. Warm glycol returns to storage tank. Pumped to dry-expansion shell-and-tube chiller, it returns to load to repeat cycle. System has three hermetic reciprocating compressors, three receiver tanks, air-cooled condensing coils with three horizontal circuits and three axial fans. It's identical to conditioning unit.

For complete information, circle No. 91 on Reader Service Card, p 102

CRANE Pressure-Seal Bonnet Valves

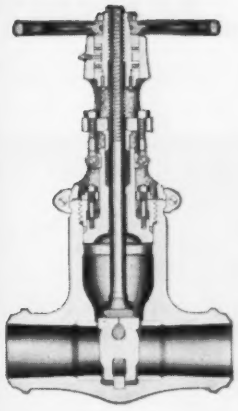
In gate, globe, angle and stop-check patterns—flanged, butt- and socket-welding ends—rated in accordance with A.S.A. in 600-, 900-, 1500- and 2500-pound classes. Sizes: gates—1 to 24 inches; globes and angles—1 to 16 inches; checks—2½ to 12 inches; stop-checks—6 to 12 inches

Crane design is at its very best in this streamlined line of pressure-seal bonnet valves—made expressly for high-pressure/high-temperature service in central stations and industrial power plants.

Bonnet joints in these valves are sealed by a unique method which uses *internal fluid pressure* to effect a leakproof seal. This method virtually eliminates bonnet-joint maintenance—and maintenance costs.

Other features include: weight-saving body design—saving up to 60% over conventional design—swivel action yoke and clamp which permits choice of position for motor or gear mechanism . . . one-piece sealing ring . . . Stellited seating surfaces.

Write to address below for descriptive Circular 1936.



CRANE *high-pressure/temperature valves assure leakproof service–less maintenance*

CRANE Lip-Seal Bonnet Valves

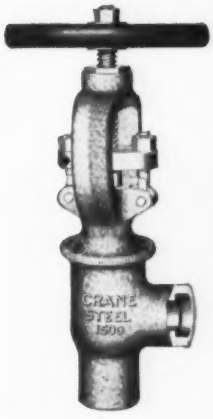
In globe, angle and lift-check patterns; sizes—½ to 2 inches; screwed and socket-welding ends; rated in accordance with A.S.A. in 1500- and 2500-pound pressure classes

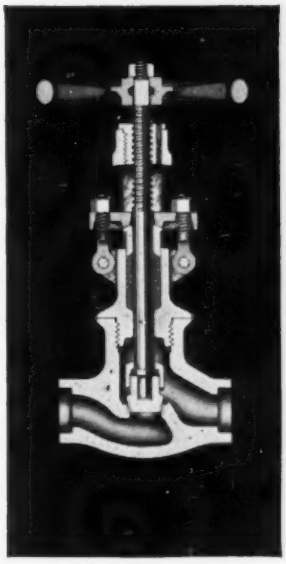
These popular Crane valves are widely used on steam, boiler feed, drips, drains, by-pass, blowdown and similar piping services.

They assure you absolute tightness, no bonnet-joint maintenance, minimum valve weight and bulk without sacrificing strength—and easy, fast dismantling and reassembly.

Features include: lip-seal design which permits re-welding without damage to the valve . . . improved disc-stem connection that minimizes vibration . . . two-piece, non-binding ball-type gland construction . . . and Stellite seating surfaces.

For details, write to Crane Co., for Circular 2099.





For prompt personal service, see your Crane Representative.

CRANE® VALVES & FITTINGS

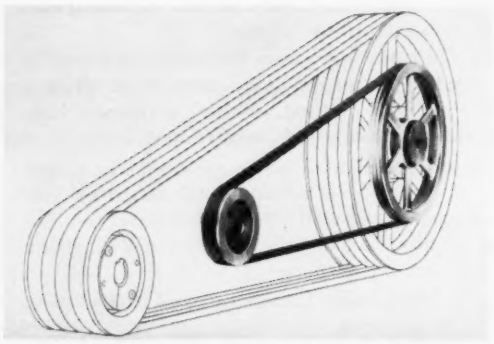
PIPE • PLUMBING • HEATING • AIR CONDITIONING

Since 1855—Crane Co., General Offices: Chicago 5, Ill.—Branches and Wholesalers Serving All Areas

In Canada: Crane, Limited 1170 Beaver Hall Square, Montreal Que.

For more data on these developments, circle key numbers on Card, p 102

Plant equipment news... Your



NARROWER BELT AND SHEAVES, reduced diameters and center distances are features of these V-belt drives. Results: major space, weight savings over conventional models, above

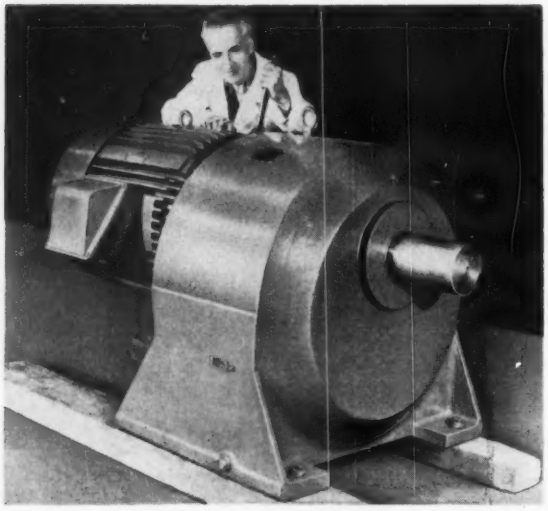
Cost reductions up to 20% promised by new V-belt drives

1 • Multiple-V belt drive with narrower, higher-capacity, deeper cross-sectioned belts and narrower sheaves presents a new concept in power transmission. Up to three times the horsepower capacity of conventional drives is packed into the same space.

Developed after five years' research, unit gives 4-way reductions: in the width of belts and sheaves, in sheave diameters, in center distances and in overall cost. Potential dollar savings are estimated at as much as 20%.

The V-belt covers drive requirements completely with three cross sections instead of five. High-performance materials are used to give extra hp capacity, so that cross-section dimensions can be made smaller.

Arched top of belt prevents distortion of the tensile section. Concave sidewalls eliminate concentrated wear on sides, insure precision fit in groove for best pulling power. Other features are super bonding of tensile member, a patented "Flex-Weave" cover.—The Gates Rubber Company



Largest standard gearmotors boast ratings of 200 hp

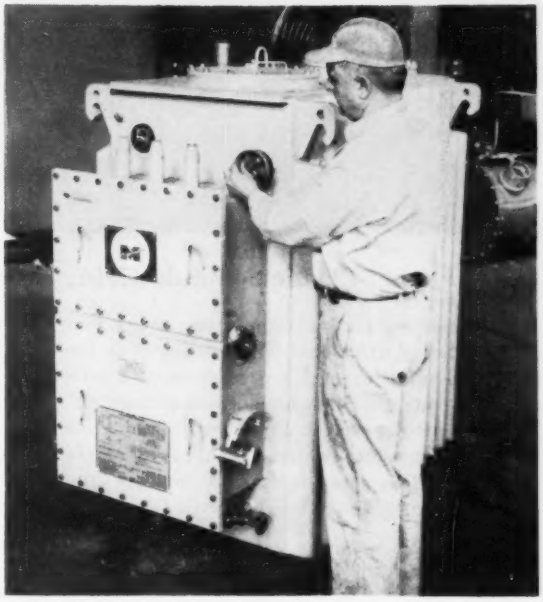
2 • Size *J* and *H* gearmotors, the largest standard-drive units ever produced, are rated up to 200 hp. Gearing efficiencies run 94 to 97%, depending on number of reductions incorporated. Double, triple and quadruple reductions are available at AGMA ratios up to 440:1.

Maximum durability and strength are designed and built into each of the drives, according to manufacturer. The final-stage helical gearing is carburized and hardened, and gear teeth are precision ground. Large-diameter shafting and oversize bearings have reserve capacity to handle severe overhung loads and shock conditions. Gears, shafting and bearings meet AGMA specs.

Standard NEMA "D" flanged motors and foot-mounted motors are available—most standard ac motors come direct from factory stock. Motors with special features can also be provided.—Philadelphia Gear Corporation

information center for new products and materials

Another electrical first: aluminum provides corrosion-resistant tank for this 500-kva network transformer

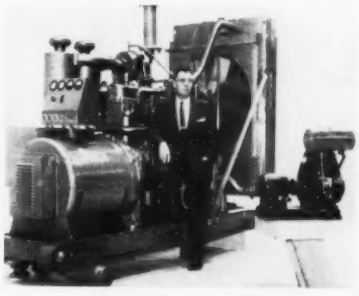


3 • Made for a 500-kva network transformer, all-aluminum case is on display at the American Institute of Electrical Engineers' general meeting in New York (Feb 2-6). The prototype tank is an optimum design from the standpoint of maintenance and cooling characteristics, according to the manufacturer. Corrugated design replaces the conventional transformer radiator tubes, eliminating side welds as a potential source of leakage and as a maintenance problem.

Alcoa 6061 aluminum alloy is the metal used. In tests ranging over 20 years, the lightweight alloy has been studied in industrial, seacoast and other environments. Results indicate that its corrosion resistance will give longer tank life and reduce the maintenance needed, to cut operation costs over network transformer's entire service life.—Moloney Electric Company

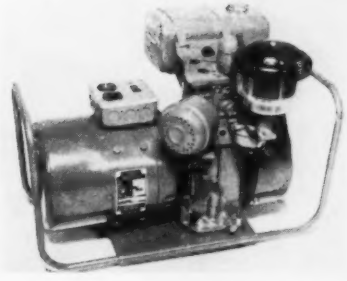
These h-t transformers are 50% smaller, 35% lighter

4 • Available in three insulation classes, general-purpose dry type transformers are smaller, lighter and up to 15 decibels more quiet than previous models. The transformers are rated 600 v and below at 25 va to 167 kva, single-phase, and 3 to 500 kva, 3-phase. They are designed with a silicone-impregnated insulation system, said to provide excellent electrical and physical characteristics. Units shown are 1, 25 and ½ kva.—General Electric Company



Standby diesel generators up ratings to 200 kw

5 • Eight new series of diesel-driven electric generating plants, rated 50 to 200 kw (62.5 to 250 kva) provide emergency power to run automatic heating systems, air conditioners, elevators, motors and lights. Stable operating conditions are established within two seconds after regular power fails. Pictured, above left, is the 200-kw model. At right is firm's first generator, a 1926 model, the "Ten-Lite," capable of lighting ten 25-w bulbs.—D W Onan & Sons, Inc



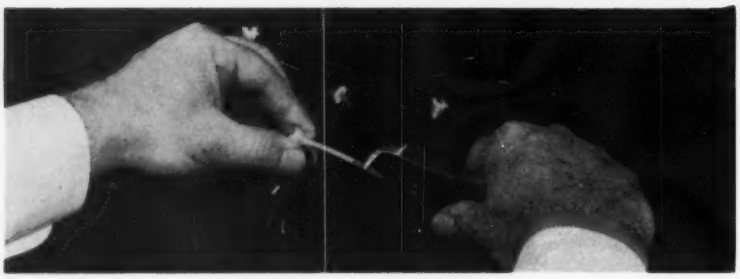
Completely portable plant can generate 750 w

6 • Designed for general power use, this 750-w electric generating plant uses a 4-pole single-phase 60-cycle 115-v-ac generator.

The first production units, now under way to Vietnam, feature a receptacle for quick disconnect, a voltage pilot light, and are isolated from vibration and radio noise. Each unit weighs 104 lb, according to maker.

Company plans to modify the same basic plant to develop 3600 rpm in a 2-pole 1500-w model.—Jeta, Inc

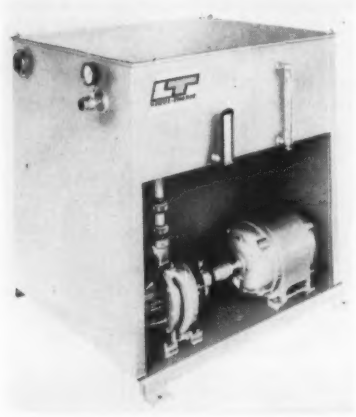
For more data on these developments, circle key numbers on Card, p 102



Plastic tie binds wiring faster

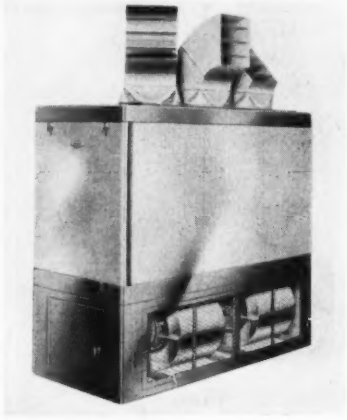
7 • Cost-saving plastic tie is faster, neater than the old string-tie method. Flexible tie, of nylon-base *Moldarta* material, has a ratchet-like design, making it self-adjusting over a wide range of bundle diameters. Holding ability is almost equal to strap's basic tensile strength, due to double tooth in buckle.

Time needed to fasten a bundle has been reduced by 30%, and the tie is fungus and moisture resistant. Tooth form allows bending to 1/32-in. radius. A plier with jaws specially designed for easy gripping is also available, to aid in installation.—Westinghouse Electric Corporation, Component Products Dept



Boiler return system comes as compact package

8 • Clean modern lines, with pump, motor and tank a single unit, are features of this boiler-return system. All gages, valves, vent and return openings are in place, ready to pipe. Low-npsh pump saves head room, and high efficiency means that lower-hp motors can be used. Systems are available in 50, 80 and 130-gal capacities, with centrifugal or turbine pumps.—Liqui-Therm Products, Inc



Industrial heater boasts quiet blower operation

9 • Output ranges of 280,000 Btu per hr and higher are available with *OG* series heaters. Units come with oil, gas or combination-fuel burners, with instant changeover by means of a single switch. Blower is quiet enough for use in schools and stores as well as general industry.

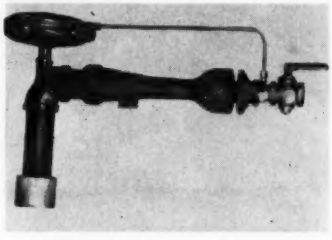
Combination air blower and individual draft blower are mounted on single shaft.—Lennox Industries Inc

I-d fan has unique air-cooling system

10 • Fuel savings, lower stack maintenance costs result from use of these specially designed i-d fans, maker claims. A radiant-heat cover installed between bearing and fan housing helps the fan maintain a constant, controlled overfire draft, increasing combustion efficiency and eliminating need for large stacks.

Unit can handle combustion gases up to 800 F. It is made of all-welded mild steel, with integral construction to prevent distortion at high temperatures. Radiant heat cover and an aluminum heat-flinger device prevent excessive radiation and permit use of standard pillow-block bearings.

Stub stacks can be installed directly on fan without additional supports, manufacturer states.—Fuller Co, Lehigh Fan & Blower Div



Venturi torch burners offer 10:1 turndown

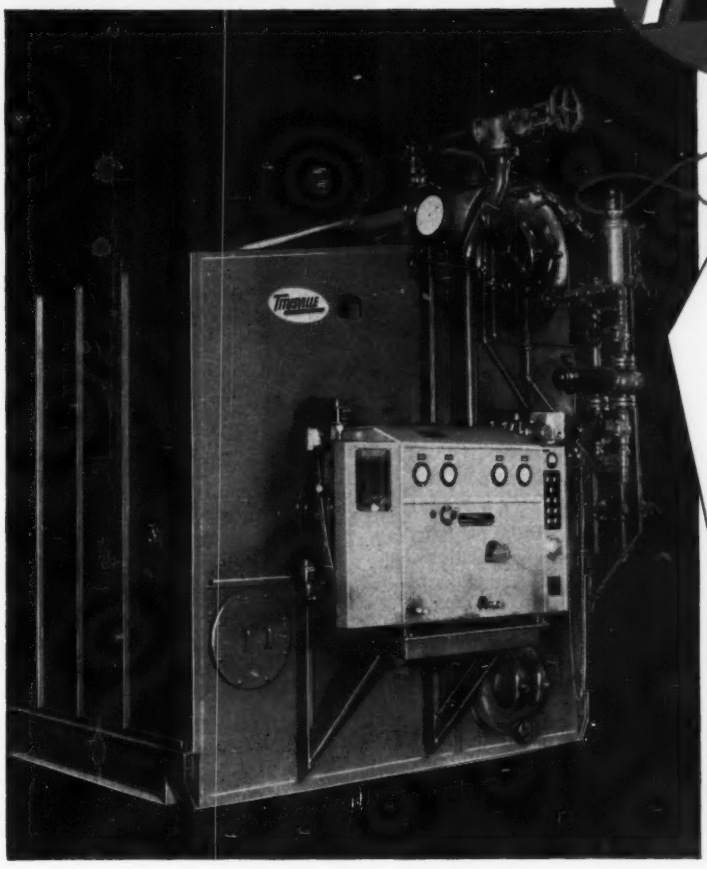
11 • Burner gives a wide range of heat control for industrial or process heating equipment such as furnaces, air heaters, ovens. Units are inexpensive, require no adjustments, feature foolproof design. With l-p gas, burner gives 10:1 turndown without flashback or loss of flame stability, according to maker. With 10-psi gas, the burner offers 16:1 turndown. The 2½-in. size provides 1,500,000 Btu per hr with 10-psi gas at high fire, 90,000 Btu per hr at low fire.

continued

For more data on these developments, circle key numbers on Card, p 102

quality-built by TITUSVILLE

BOILERS SINCE 1860



the Titusville type WTP

packaged steam generator

A completely factory-assembled, fully-equipped steam generator, the popular Titusville Type WTP is easily transported by rail or truck—ready for operation as soon as connected to fuel, steam and utility services. Compact in size, of TITUSVILLE quality in every detail, this advanced unit is supplied in capacities from 10,000 to 60,000 lbs of steam per hour. *Let us quote on your needs.*

THE TITUSVILLE IRON WORKS CO.

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Manufacturers of A Complete Line of Boilers for Every Heating and Power Requirement

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BOILERS for Power and Heat . . . High and Low Pressure . . . Water Tube . . . Fire Tube . . . Package Units

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Crankshafts . . . Pressure Vessels . . . Hydraulic Cylinders . . . Shafting . . . Straightening and Back-up Rolls

For more facts circle 260 on Reader Service Card, p 102

a good team for steam

This Yarway team has scored high—over a million installed on all types of steam equipment. Stocked and sold by 270 Industrial Distributors. For free Steam Trap Book, write YARNALL-WARING CO., 100 Mermaid Ave., Philadelphia 18, Pa.

go YARWAY with confidence

Equipment news

Begins on page 116

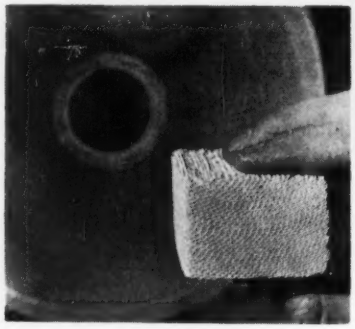
Unit operates under furnace drafts up to 2.0-in. water column and gas pressures from 4-in. water column to 20 psig. Burner capacities range from 120,000 to 1,800,000 Btu per hr for the low-pressure, 200,000 to 9,300,000 Btu per hr for the medium-pressure series. — Bryant Industrial

Refrigeration machine

12 • Industry's largest hermetic centrifugal refrigeration machine boosts capacity of firm's line to 1500 tons. A major advantage is low installation cost per ton of refrigeration capacity, possible because of minimum electrical service required, use of a single compressor-motor and starter, and good performance characteristics.

Hermetic motor is kept cool by refrigerant passing around and through the motor windings, plus special star-delta starter connections. —Carrier Corporation

Just circle key numbers on the Reader Service Card, page 102, to get complete product story



High-temperature ceramic

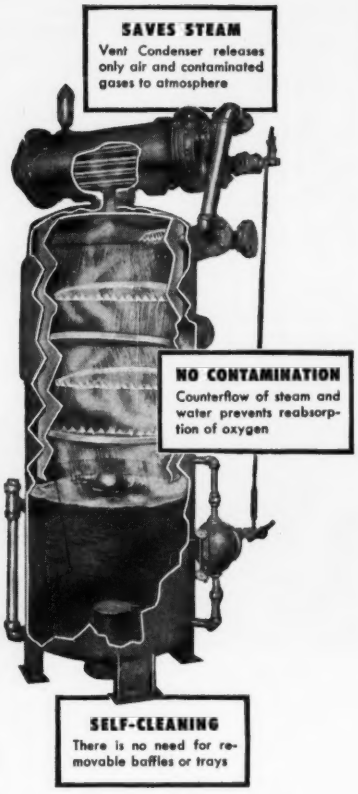
13 • Extremely thin-walled ceramics have been formed into lightweight honeycomb structures capable of operating at high temperatures. The new materials can withstand temperatures up to 1800 F with virtually no thermal expansion, and can operate continuously at 1290 F. At these temperatures they are resistant to oxidation and corrosion.

Another feature is a low coefficient of thermal expansion—$1x10^{-7}$ per deg C, from 0 to 300 C. Cercor materials can withstand extreme thermal shock, maker states.

Suggested applications include

Stop Corrosion
in boilers, steam and return lines...

with this Stickle deaerating feed water heater


SAVES STEAM
Vent Condenser releases only air and contaminated gases to atmosphere
NO CONTAMINATION
Counterflow of steam and water prevents reabsorption of oxygen
SELF-CLEANING
There is no need for removable baffles or trays

Stickle Baffle Spray Type Deaerating Feed Water Heaters stop corrosion by removing destructive oxygen and carbon dioxide from boiler feed water . . . reduce fuel costs and boiler strain. Vertical and horizontal models. Capacity range: 3,000 to 300,000 pounds per hour. The latest development in more than 50 years of building feed water heaters.

FREE CATALOGS!
S-217 . . . Baffle Spray Type Deaerating Feed Water Heaters
117 . . . Open Coil Feed Water Heaters

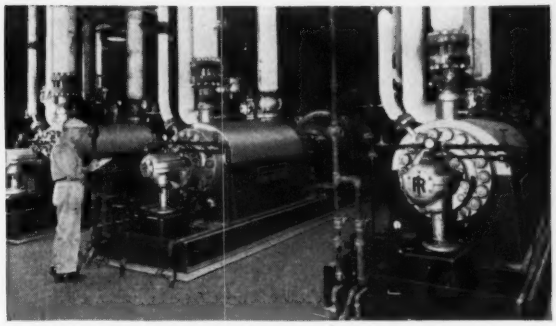
STICKLE STEAM SPECIALTIES CO.
2265 Valley Ave. • Indianapolis 18, Ind.

Stickle Equipment
Cuts the cost of steam

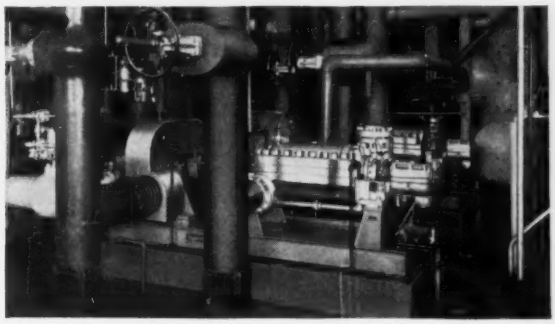
BOILER FEED PUMPS GIVE DEPENDABLE PERFORMANCE

at all pressures, capacities, temperatures.

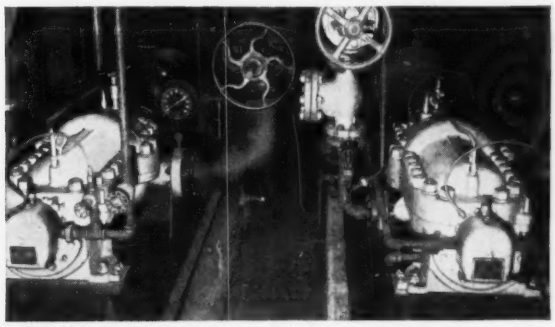
Typical I-R installations indicate wide range of use in central stations and industrial plants



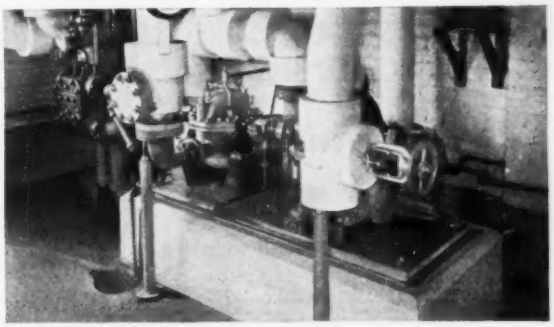
PRESSURES UP TO 6500 psi.—Class CHTA-CHTB: These multi-stage, cylindrical "double-case pumps meet the most exacting needs of the highest-pressure boilers in modern central station service. Each of the above pumps handle 1100 gpm of feedwater at 2395 psi.



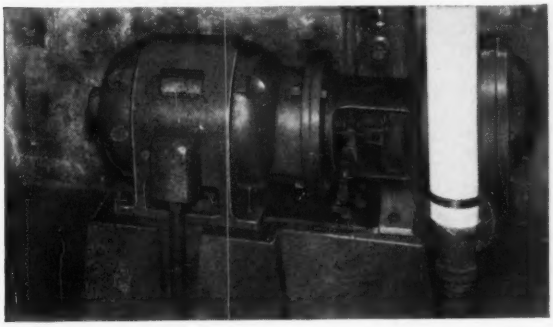
PRESSURES UP TO 1200 psi.—Class HMTA-HMTB: A complete line of multi-stage centrifugal pumps featuring a symmetrical, horizontally-split casing, and a simplified unit-type rotor assembly. The pumps illustrated are on boiler feed service in a large textile mill.



MEDIUM PRESSURES UP TO 1000 psi.—Class CNTA: Symmetrical design with unit-type rotor gives CNTA pumps higher efficiency, easier maintenance, and attractive modern appearance. Installed in a large paper mill, the boiler feed pumps shown operate at 3560 rpm and deliver 180 gpm at 605 psi.



PRESSURES TO 450 psi.—Class GT: Dependability is designed into this line of two-stage, horizontally split pumps. Standard construction includes renewable wearing rings and water-cooled, ring-oiled bearings. Pump shown serves as a boiler feed unit in a large candy factory



PRESSURES TO 250 psi. — Motorpumps: A complete line of space-saving centrifugal pumps, including both close-coupled and cradle-mounted types. Single , two-stage, and vertical four-stage models are available. Pump shown is handling boiler feed in a leather factory.

Ingersoll-Rand boiler feed pumps have many refinements in design and construction that add up to high operating efficiency. Skilled manufacture and painstaking factory inspections assure dependability built into every pump. Inherent simplicity and ruggedness mean easier and less maintenance—and trouble-free performance.

Whatever pressure or capacity you need, Ingersoll-Rand can supply a boiler feed pump for the job. I-R engineers will gladly help you select the pump that meets your needs.

Ingersoll-Rand

10 - 380 **11 BROADWAY, NEW YORK 4, N.Y.**

COMPRESSORS • GAS & DIESEL ENGINES • AIR & ELECTRIC TOOLS • CONDENSERS • PUMPS • ROCK DRILLS • VACUUM EQUIPMENT

For more facts circle 263 on Reader Service Card, p 102

END VIBRATION DAMAGE

Robertshaw's Vibraswitch Malfunction Detector protects machinery from costly damage resulting from excessive vibration. Sensing instantly the beginning of destructive vibration caused by *failing bearings, bent shafts, broken blades* or *overspeeding,* Vibraswitch actuates an alarm or shuts down the malfunctioning equipment.

Available in various models, Vibraswitch may be easily installed on large motors, pumps, fans, compressors and other rotating or reciprocating machinery. Write for Technical Bulletin RF-586.

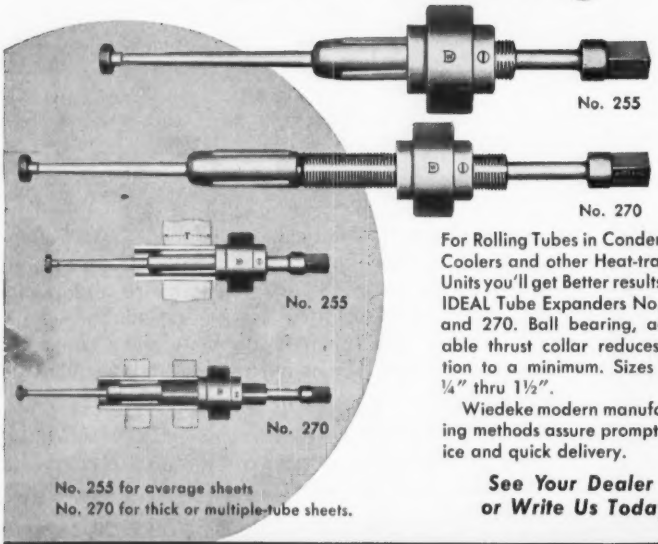
Aeronautical and Instrument Division, Robertshaw-Fulton Controls Company, Santa Ana Freeway at Euolid Avenue, Anaheim, California.

For more facts circle 264 on Reader Service Card, p 102

IDEAL TUBE EXPANDERS

Precision-Built for faster, smoother

Tube Rolling



No. 255 for average sheets
No. 270 for thick or multiple-tube sheets.

For Rolling Tubes in Condensers, Coolers and other Heat-transfer Units you'll get Better results with IDEAL Tube Expanders No. 255 and 270. Ball bearing, adjustable thrust collar reduces friction to a minimum. Sizes from ¼" thru 1½".

Wiedeke modern manufacturing methods assure prompt service and quick delivery.

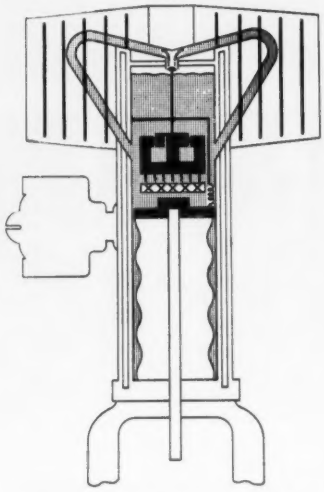
See Your Dealer or Write Us Today!

THE GUSTAV **WIEDEKE** COMPANY
DAYTON 1, OHIO

Equipment news

Begins on page 116

gaseous heat exchangers, catalyst supports and structural materials for h-t use.—Corning Glass Works

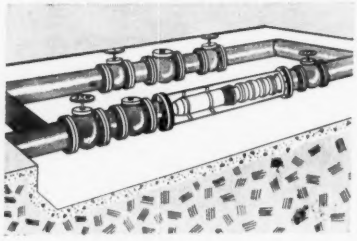


Actuator develops 500 lb

14 • Using the expansive force of Freon vapor, this actuator can position valves and other final control elements with precise, repeatable accuracy. It develops a force of 500 lb, opposed by a 300-lb return-spring force, gives a total stroke length of 1.5 in., a response speed of 0.1 in. per sec.

Unit operates by a controlled rate of heat release through a fluid medium, Freon, circulating in a closed chamber open only to a condenser. Control action is achieved by varying bleed rate of Freon into condenser.—Swartwout Company

Just circle key numbers on the Reader Service Card, page 102, to get complete product story



Submersible pipeline pump

15 • Horizontal pipeline booster pump operates within the pipe itself. Pump is suspended in a special section of pipeline, centered and held by spiders. Line liquid is drawn past

For more facts circle 265 on Reader Service Card, p 102

circle 266 on Reader Service Card, p 102 ➤

"SPECIAL" Welding Fittings by MIDWEST

"SPECIAL" DESIGNS

"SPECIAL" MATERIALS

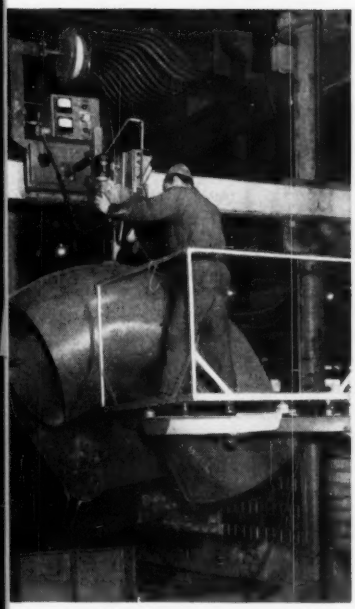
"SPECIAL" QUALITY

"SPECIAL" DELIVERY

Special gauges and instruments are used to make sure that we have complied with the extremely close tolerances often required on stainless fittings. Here wall thickness and concentricity were held within extremely close limits throughout the fittings.

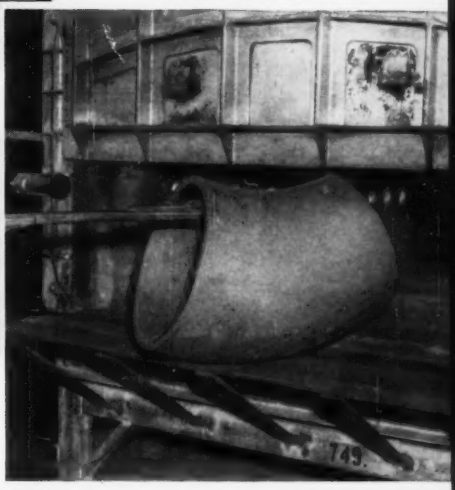
The exclusive Midwest method of manufacture—much more versatile and flexible than any other—enables us to make almost any type of special welding fittings to the most rigid specifications. Midwest makes welding fittings from *plate* . . . usually much easier to get than pipe, particularly if the material is special. That expedites delivery. Closer tolerances are inherent in the Midwest process, and quality control is always beyond code requirements.

Even if you use only standard fittings, the exceptional quality of Midwest fittings can be important to you. Ask your Midwest distributor or write us for new Bulletin 5801.



36" O.D. 90° elbow with 16" tangent on one end being welded by an automatic submerged arc machine. Material is A-201 carbon steel.

Stainless-clad elbows undergoing ultrasonic inspection to check bonding of material and quality of weld. Since plate is often the only form in which clad material is available, the Midwest process is able to produce the most comprehensive range of clad fittings—and to do so promptly.



Special 24" x 21" 45° reducing elbow made of 1" thick 1¼% chrome ½% moly steel ready for heat treating furnace.

MIDWEST PIPING COMPANY, INC.

Main Office: St. Louis 3, Mo. (P.O. Box 433)

PLANTS: ST. LOUIS, CLIFTON, N. J. and LOS ANGELES

SALES OFFICES:

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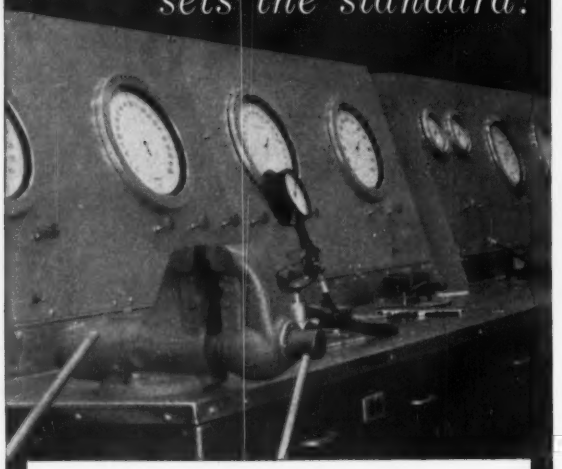
Boston 27—426 First St. • Chicago 3—79 West Monroe St.
Cleveland 14—616 St. Clair • Houston 2—1213 Capitol
Los Angeles 33—520 Anderson • Miami 34—2103 Le Jeune
New York 7—50 Church St. • Pittsburgh 19—437 Grant St.
San Francisco 11—420 Market St.
St. Louis 4—1450 South Second St.
Tulsa—1640 E. 21st St.

STOCKING DISTRIBUTORS IN PRINCIPAL CITIES

8059

ACRAGAGE®

sets the standard!



NORTHROP CHOOSES ACRAGAGE FOR AIRCRAFT TEST GAGE CALIBRATION!

Laboratory test gages must provide the utmost in dependability, accuracy, and sensitivity. Thus it was only natural for Northrop Aircraft, Inc. to choose Acragage for calibrating aircraft test gages. Seven 12" and two 4½" Acragage Solid Front Test Gages are used in the instrument repair shop of Northrop's engineering test laboratories.

This particular Acragage application is typical of the faith placed in products bearing the Acragage name. It's a faith borne of quality workmanship and outstanding features touching on the **entire** Acragage line of products, standard service gages as well as test gages. These features include the solid front case with full area rear blowout disc for positive protection, the longer Bourdon Tube (for greater tip travel assuring consistently accurate indication), and a wide choice of tube materials. Whatever your gage requirements, Acragage stands ready to serve you with the finest line of indicating instruments. Mail coupon for more information and catalog!

ACRAGAGE GIVES YOU MORE GAGE PER DOLLAR

- VACUUM GAGES
- PRESSURE GAGES
- COMPOUND GAGES
- TEST GAGES
- ELECTRIC TRANSMITTER GAGES
- PNEUMATIC TRANSMITTER GAGES
- RECEIVER GAGES
- CHEMICAL PROTECTORS

INTERNATIONAL REGISTER COMPANY / INSTRUMENT DIVISION

Quality Products since 1891

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Gentlemen: Please send me full information on Acragages and a copy of Bulletin No. 29D

Name_____

Title_____

Firm_____

Address_____

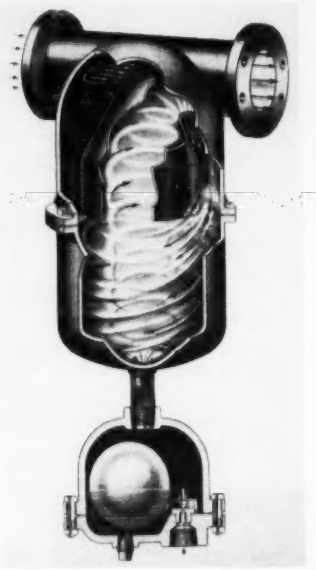
City_____ Zone____ State_____

Equipment news

Begins on page 116

motor and into bowl assembly which passes it along at greatly increased pressure.

Noiseless operation, economy and dependability are features, and unit also eliminates need for pump houses and guards against motor damage from heat, dust and moisture. Units operate within pipe from 8 to 24 in. dia, giving capacities from 100 to 4000 gpm in heads from 50 to 500. —Layne & Bowler Pump Co



Entrainment separator

16 • Designed for steam, air or gas applications, unit uses centrifugal force to separate moisture and oil entrained in vapor flow. Vapor is directed through an annular passage which increases speed and centrifugal force. Entrained matter clings to outer wall, then drains downward to an automatic trap. Entrance to the outlet chamber is enlarged to reduce velocity, eliminate re-entrainment problems.

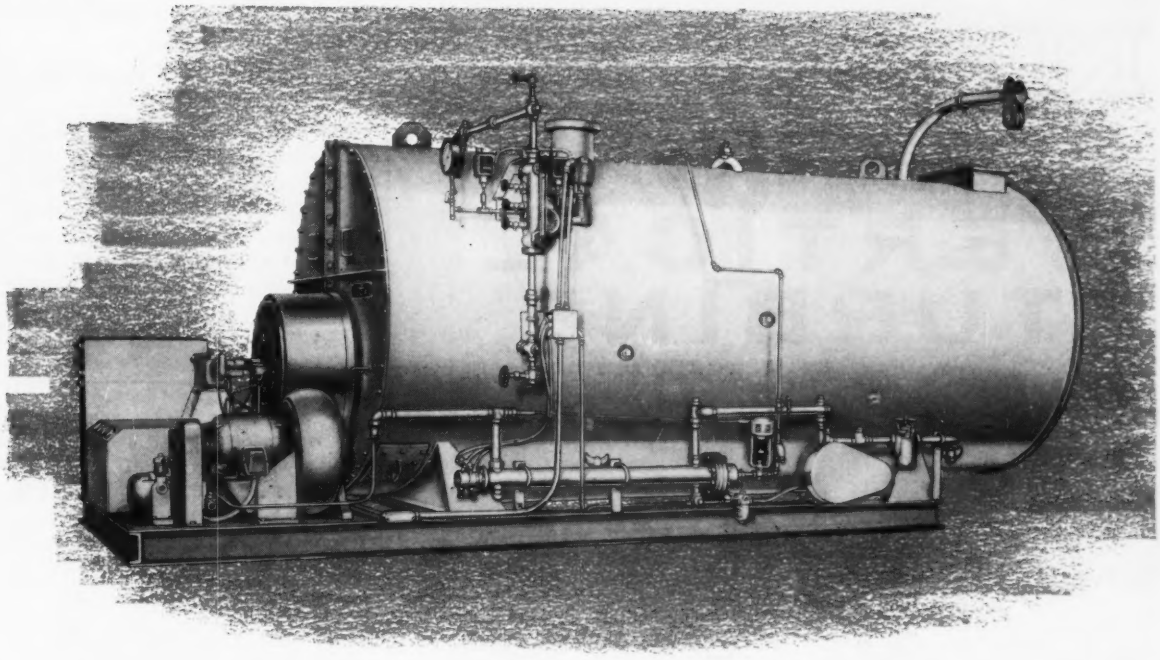
The series comes with screwed connections through 3-in. and flanges through 8-in. pipe sizes.—Wright-Austin Company

Just circle key numbers on the Reader Service Card, page 102, to get complete product story

High-impact air vibrator

17 • Designed for electrostatic precipitators and dust collectors, unit has 1-piece construction for heavy

For more facts circle 267 on Reader Service Card, p 102



You can't buy them.....

Better Designed

Behind this Erie City "FT" package unit is the manufacturing skill and engineering know-how acquired through more than a century of producing large, high pressure, water tube and fire tube industrial power boilers.

The "FT" has five full square feet of heating surface (ASME basis) per developed horsepower. The 3-pass design places the gas vent at the rear where it belongs. Carefully proportioned gas areas through three lengths of the boiler take into consideration reduced gas volume as heat is being rapidly absorbed by the surrounding water. The "FT" is a pressurized unit using forced draft to provide precise control of excess air and CO_2 — no leakage of outside air into the combustion chamber is going to lower the efficiency.

Better Built

The same modern shop practices and quality workmanship used on our largest power boilers are used on these package fire tube steam generators. Every "FT" is of welded construction, stress relieved and X-rayed as part of the quality built into this unit. The "FT" is built for easy installation and complete accessibility. A full length, rigid, all welded structural steel base carries the entire package unit, permitting quick and easy installation anywhere without the use of skids and without excavation or foundation work. The front and rear heads are constructed of insulated, sectional panels for complete accessibility to the tubes and combustion chambers.

Every Erie City "FT" is built to highest quality — not down to a price.

Better Serviced

Every "FT" is designed, built, assembled, piped, wired and *Factory Fire Tested* by Erie City Iron Works. A complete package steam generator ready to go to work when it reaches the customer's plant.

A *factory trained* Erie City field service engineer will supervise the initial start-up and will instruct the operating personnel in the proper operation of the unit. This feature of using *factory trained* service engineers plus *Factory Fire Testing* results in a correctly adjusted, efficient steam generator.

Investigate all the advantages of the Erie City "FT" package fire tube. Catalog literature is available and an Erie City District Sales Agent will be pleased to show you an "FT" in operation.

For the quality fire tube package "FT"—write for Catalog 5691B

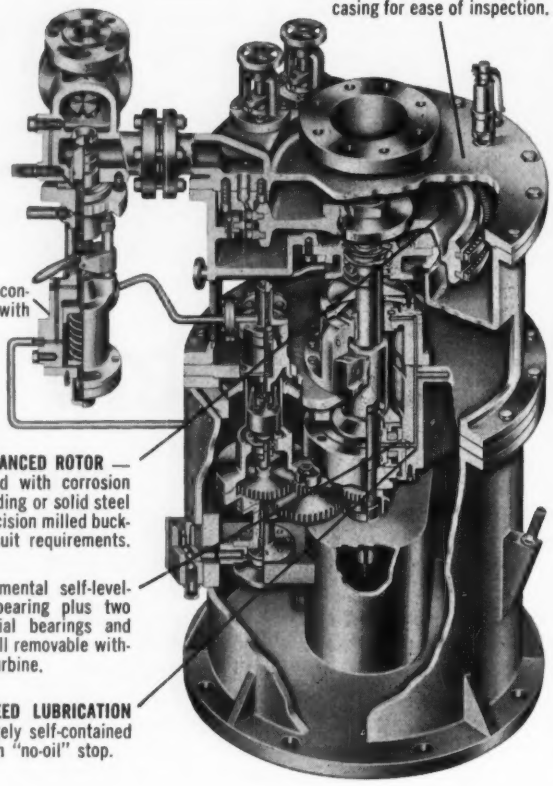
• You can depend on ERIE CITY *Since 1840* *for sound engineering*

ERIE CITY IRON WORKS • *Erie, Pennsylvania*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS • WASTE HEAT BOILERS
FIRE and WATER TUBE PACKAGE BOILERS • OIL and GAS BURNERS • STOKERS • PULVERIZERS

NEW Whiton VERTICAL TURBINE

Type BHBSV for Vertical Pump Drives



CASING — Horizontally split casing for ease of inspection.

SPEED CONTROL — Oil constant speed governor with overspeed stop.

DYNAMICALLY BALANCED ROTOR — Either steel forged with corrosion resistant steel blading or solid steel one piece with precision milled buckets available to suit requirements.

BEARINGS — Segmental self-leveling type thrust bearing plus two babbitt lined radial bearings and shaft packing — all removable without dismantling turbine.

FORCED FEED LUBRICATION — Completely self-contained system with "no-oil" stop.

The Whiton Vertical Turbine is extremely versatile, compact and dependable . . . ideal for vertical pump drives and other similar applications. The vertical design requires minimum installation space and allows great freedom of location. Simplicity of design and construction results in ease of operation and servicing.

With this vertical turbine added to the line, Whiton's vertical and horizontal steam turbines offer a broad range of power supply applications. Complete data on the new vertical turbine and others available on request.

MAXIMUM OPERATING SPECIFICATIONS	
POWER	to 1000 HP
SPEED	to 8500 RPM
STEAM PRESSURE	to 1250 PSIG
STEAM TEMPERATURE	to 1050° FTT

Whiton SINCE 1856

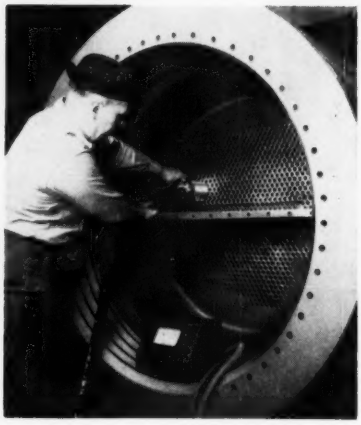
THE WHITON MACHINE COMPANY
NEW LONDON, CONNECTICUT

Equipment news

Begins on page 116

duty. The piston is the only moving part. Unit is said to practically eliminate maintenance problems. Vibrators can also be arranged with timer and solenoid valve for complete automatic control. They weigh 52 lb.— National Air Vibrator Co

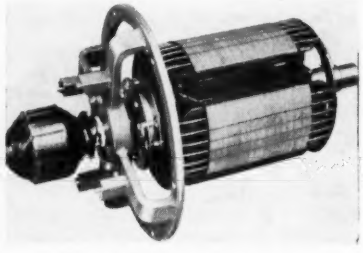
Just circle key numbers on the Reader Service Card, page 102, to get complete product story



High-pressure closure design

18 • Simplified closure design is said to have operating advantages for feedwater heaters, other h-p, h-t exchangers produced by company.

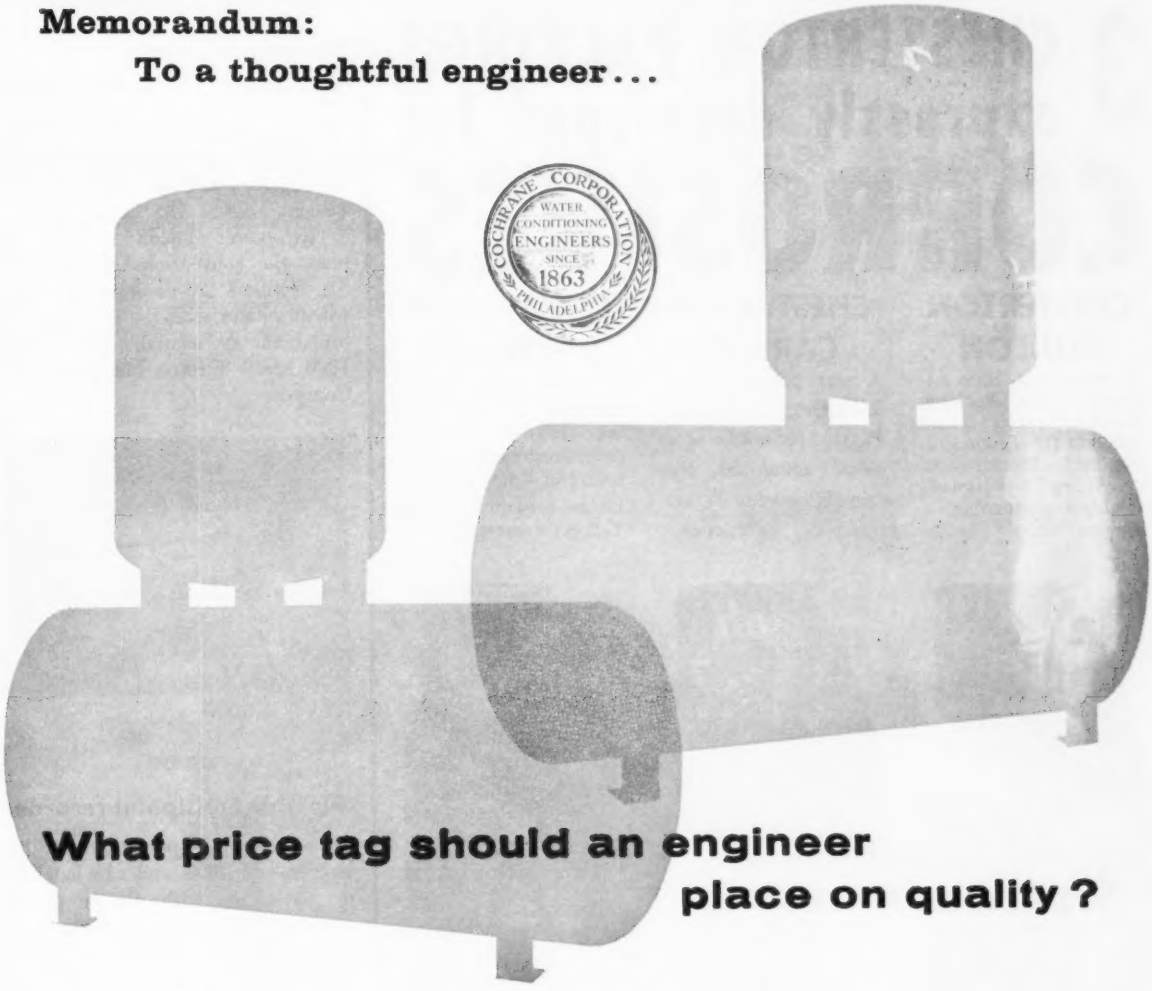
Structural design is conservative. Hydrostatic load is transmitted directly to channel cover to be carried by heavy buttress engagements. Stresses of shear and bearing for the load-carrying channel and cover are low, and bearing surfaces for both components are identically spaced for uniform load distribution, according to the manufacturer. — American-Standard, Ross Heat Exchanger Div



Brushless generators

19 • New design for ac power is a brushless generator. Machines have no commutator, slip rings or commutator or slip-ring brushes. Avail-

Memorandum:
To a thoughtful engineer...



What price tag should an engineer place on quality?

These two medium sized deaerators look alike. We designed both. They have the same outlet capacity, carry similar guarantees and meet the ASME code. But one costs $2000 more than the other.

Which is the better buy?

Obviously, you would want to know more about each unit in order to make a sound decision. Construction to ASME standards and basic guarantees are but part of the quality story. The higher priced unit, for example, has far heavier shell plate, more tray area and spilling edge, superior shell reinforcement, stainless instead of carbon steel baffle, anti-flash downtake. All of these features, we have found, are important to continued top performance.

As one of the world's largest and most experienced manufacturers of deaerators, we believe we know which unit is the better buy. Extra margins of strength and capacity—wisely selected—are not luxuries but sound investments that eliminate downtime and expensive field repairs.

That is why we recommend *quality*, and why thoughtful engineers insist on *quality*. If you are considering the purchase of deaerating equipment we are prepared to help you evaluate *all* the features that mean *true economy* in service. Ask for Bulletin 4650 on the "Why and How of Deaeration"

Write for these five bulletins on Deaeration—the problem, types of deaerators and applications.

Cochrane CORPORATION

3106 N. 17th Street, Philadelphia 32, Pa.

Philadelphia • New York • Chicago

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Representatives in thirty-two principal cities in U.S., Hawaii, Puerto Rico; also Havana, Cuba; Paris, France; La Spezia, Italy; Mexico City, Mexico; Caracas, Venezuela; Santiago, Chile.

POTTSTOWN METAL PRODUCTS DIVISION—
Custom built carbon steel and alloy products.

Demineralizers • Zeolite Softeners • Hot Process Softeners • Hot Lime Zeolite Softeners • Dealkalizers • Reactors • Deaerators • Pressure Filters
Continuous Blowoff Systems • Condensate Return Systems • Steam Specialties

For more facts circle 270 on Reader Service Card, p 102

3 CHESTERTON PACKINGS expressly developed for CORROSIVES

CHESTERTON BLU-LON

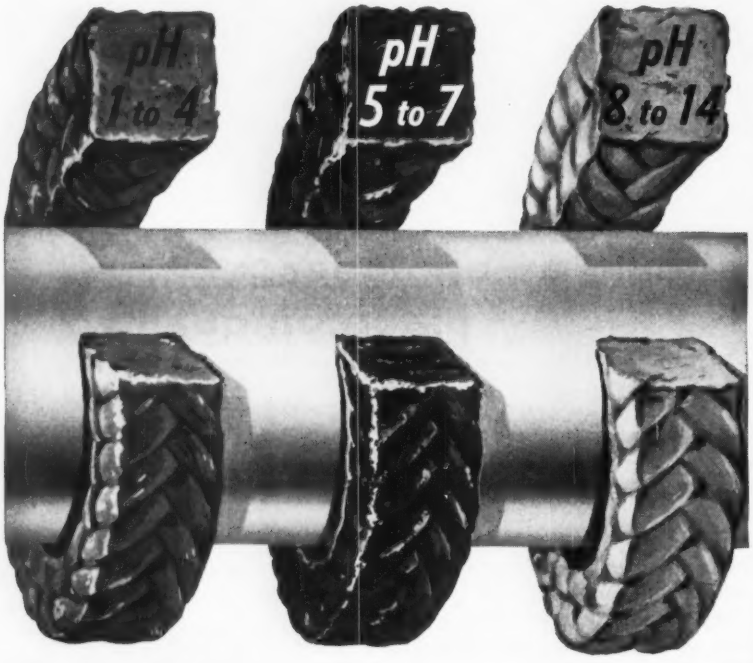
A ***severe acid,*** Blue Asbestos Teflon Packing. Each asbestos strand individually Teflon immunized. Special acid resisting lubricant. Highly compressible — no graphite.

CHESTERTON CARSON

A soft, pressure lubricated, Graphite Asbestos Packing for ***mild acid or alkali*** conditions. Retains lubrication — low coefficient of friction.

CHESTERTON WHITE-LON

A ***strong alkali,*** White Asbestos Teflon Packing. Highly compressible, caustic resisting lubrication. White in color. Each asbestos strand Teflon impregnated.



THE THREE SPECIALIZED ROD PACKINGS illustrated above have been developed by Chesterton to meet specific pH values *through the entire corrosive range.* Each packing is a leader in its particular field because Chesterton is dedicated to giving unequalled performance rather than price. A very few cents a pound is well invested in trouble-free — labor-free years of service. We welcome inquiries.

PACKING Chesterton SERVICE

A. W. CHESTERTON CO. • EVERETT 49, MASS.
America's Oldest Manufacturer of Mechanical Packings

Equipment news

Begins on page 116

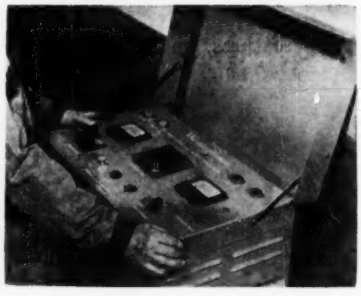
able in ratings from 6.25 to 187 kva, packaged generators come complete with static voltage regulator and meters.

High-power silicon rectifiers replace the conventional commutator. Six rectifiers are mounted on a ring which rotates with the generator rotor. Units are available at 1200 and 1800 rpm.—Electric Machinery Mfg Company

Flexible multipoint recorder

20 • Low-cost potentiometer has built-in versatility and can handle 2 to 24 points with simple plug-in adapter units, above. To change number of points, operator changes a plug-in unit, replaces dial indicator and print wheel which are mechanically geared with the selector switch. Changeover takes about three minutes.—Weston Instruments, Div of Daystrom Incorporated

Just circle key numbers on the Reader Service Card, page 102, to get complete product story



Industrial x-ray control

21 • New 150- to 250-kv X-ray control can produce clearly defined images through ⅛ in. of aluminum or four in. of steel. Unit is said to offer a range of 30 to 250 kv.

The circuitry has built-in overload

NEW... from K&M

EXTERNAL PILOT-OPERATED PRESSURE REGULATOR

fast-acting, accurate . . . tight shut-off even on dead-end service

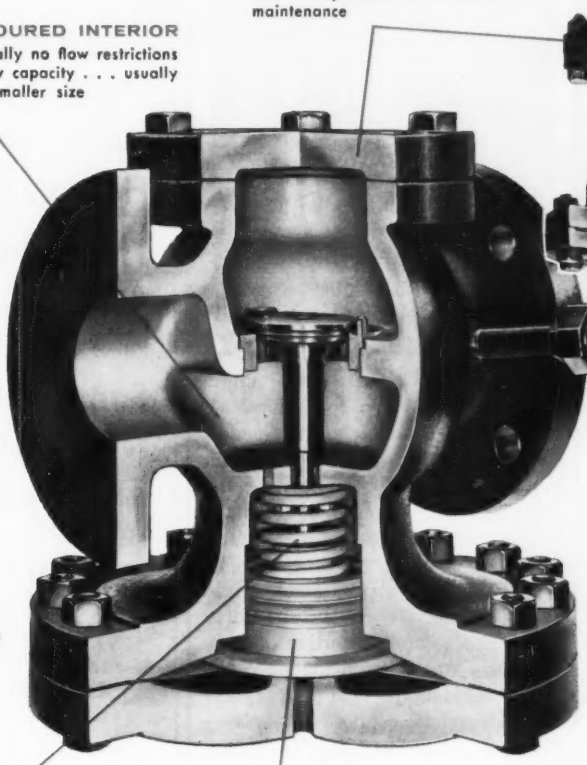
Examine it yourself . . . feature for feature. K&M has made a vast improvement in external pilot-operated pressure regulators.

It simplifies installations: *requires one less pipe line.* It offers lowest maintenance: *the result of good hydraulic and mechanical design throughout.* It gives excellent performance: *try one and compare with any other regulator of its type.*

BUILT-IN STRAINER
protects pilot from scale, dirt, other foreign matter, is removable for cleaning

BLIND FLANGES
on both main valve and pilot allow easy access for routine maintenance

CLEANLY CONTOURED INTERIOR
has no spider, practically no flow restrictions . . . gives greater flow capacity . . . usually permits economy of smaller size



INTEGRAL BLEED ORIFICE
eliminates need for installation of extra bleed line

PRESSURE-ADJUSTING SCREW
permits convenient external pressure setting

GUIDE PISTON
has balancing grooves which hydraulically center guide, prevent binding and side-thrust

CONTROL SPRING
is isolated from main flow stream for greatest protection

If you would like a more detailed, close-up look at K & M's new Type 471 External Pilot Pressure Regulator, send for Bulletin 471A.

K&M diaphragm control valves

Our 79th Year

KIELEY & MUELLER, INCORPORATED

Oldest Pressure and Level Control Valve Manufacturer
64 Genung Street, Middletown, New York

S.A. 1808

For more facts circle 272 on Reader Service Card, p 102

CLEANS ECONOMICALLY

VEGO
ELECTRIC MOTOR CLEANERS

Cleans Safely, Easily

VEGO No. 17
Light Degreaser

VEGO H-18
No Flash

VEGO No. 15CC
Cold Cleaner
(gov't spec. safety cleaner)

There's a VEGO Electric Motor Cleaner that will make quick work of cleaning and degreasing all types of electric motors, generators, mill and factory machinery. Easy to use. In most cases it accomplishes its purpose in a single operation.

— Thorough Laboratory Control —

• **Also VEGO No. 31**
Emulsion Cleaner

Write Dept. G for information on aluminum cleaners, rust removers, anti-corrosion coatings, or tailor-made products for your specific needs.

CHEMICALS & MATERIALS CORPORATION
Terre Haute, Indiana

VEGO®
PRODUCTS OF QUALITY FOR INDUSTRY

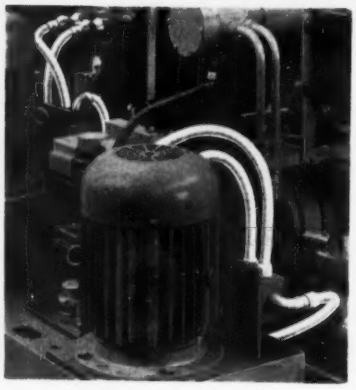
circle 273 on Reader Service Card, p 102

Equipment news

Begins on page 116

and overvoltage protection. Either automatically stops the instrument. Indicator light signals overload, and excessive voltage is seen on a direct-reading kv meter. — Westinghouse Electric Corporation, X-Ray Dept

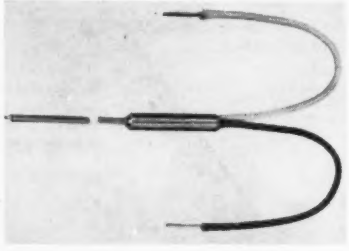
Just circle key numbers on the Reader Service Card, page 102, to get complete product story



Pliable electrical conduit

22 • Tube formation composed of layers of continuous metal allows maximum protection for cables, according to manufacturer. Conduit can be set and bent to negotiate corners and curves, eliminating the need for bends and elbows. It is pressure-sealed to keep out oil and water.

The conduit remains almost rigid after bending, and can be shaped to any radius without distortion of bore. It can be made in ductile materials and combinations such as stainless steel, aluminum, copper and paper.— Gemmer Manufacturing Company, Kopex Div



Rough-service thermocouples

23 • These thermocouples are designed to meet severe demands of nuclear reactors, melting furnaces. Various metal combinations are used —copper-constantan for temperatures

MOVING? CHANGING ADDRESS?

Remember—
it takes about
a month to make
the change.

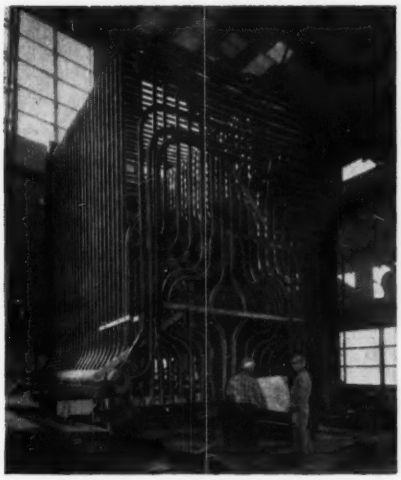
Help us to give
you better
service.

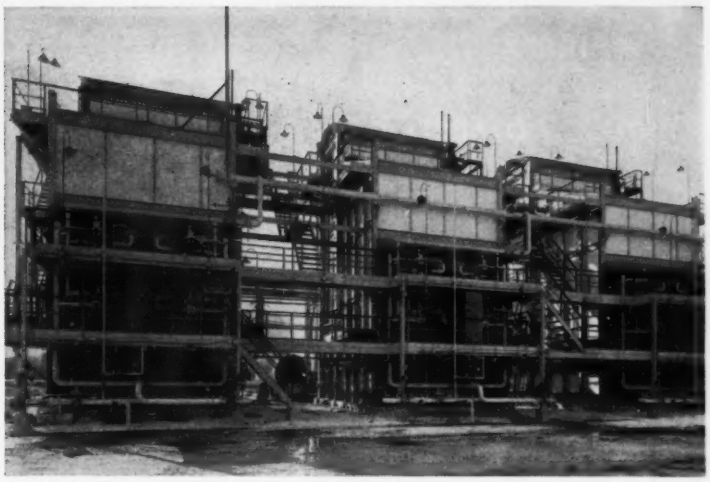
Send us the
old addressing
label
AND
your new
address.

BE SURE TO INCLUDE THE ZONE NUMBER!

Address:

Fulfillment Manager
POWER
330 West 42nd St.
New York 36, N. Y.





AT LEFT: Installing a 60,000 lbs/hr unit in a brewery

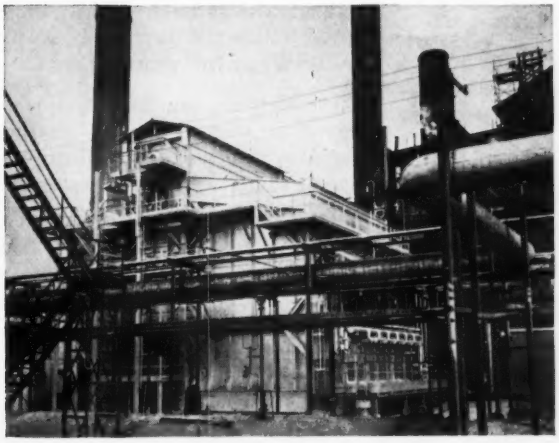
ABOVE: A battery of 125,000 lbs/hr units in a chemical plant

CUSTOM *Steam* GENERATORS by Vogt

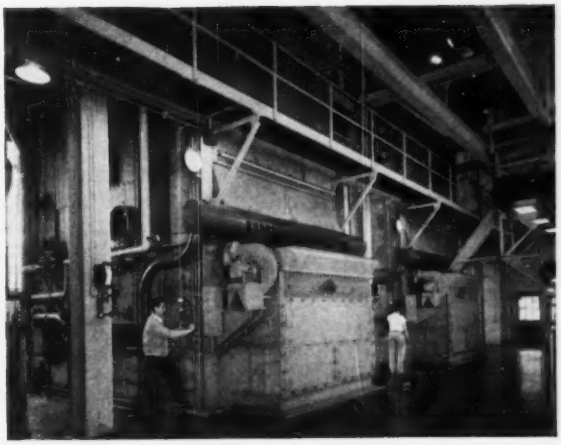
Vogt engineering advances can save you money if you have a steam generating problem. Custom-built installations shown, are engineered to assure efficient, dependable steam generation for power, process and heating. Our engineering staff is available to give effective help in the solution of steam generating problems peculiar to a wide variety of operating conditions. Address Dept. **24A-BP.**

HENRY VOGT MACHINE CO.
LOUISVILLE, KENTUCKY

SALES OFFICES: New York, Chicago, Cleveland, Dallas, Camden, N. J., St. Louis, Charleston, W. Va., Cincinnati



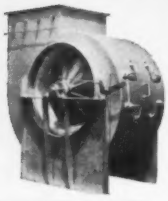
This 400,000 lbs/hr unit is installed in a leading petroleum refinery



Three 40,000 lbs/hr units serve a medical center

For more facts circle 274 on Reader Service Card, p 102

WHIRLEX
Shop Assembled
DUST COLLECTORS . . .



WHIRLEX FORCED DRAFT FANS are designed for heavy duty service in all types of boiler applications. Airfoil bladed impeller provides maximum static efficiency.

- - - Eliminate Costly Field Assembly

Whirlex dust collectors are designed to provide maximum collection efficiency for each specific type of application. The unit is then fabricated and completely shop assembled and need only be set in place and the hoppers bolted on at the installation site. Each Whirlex unit is rigidly inspected before it leaves the shop, assuring a completely "gas-tight" installation.

More specific information is available upon request.

Fly Ash Arrestor
CORPORATION
204 North First Street • Birmingham, Alabama

Dust Collectors • Induced Draft Fans
Forced Draft Fans • Exhaust Fans
Self Supporting Stacks • Duct Work

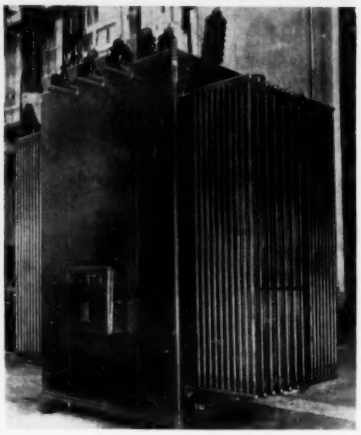
FLY ASH WHIRLEX ARRESTOR

Equipment news

Begins on page 116

down to –300 F; rhodium-platinum for temperatures over 1600 F.

Conductors are encased in ceramics, surrounded by chemically clean metal sheaths. Insulation resistance between wires and sheath ranges up to 100 megohms at 500-v dc. Dielectric strengths are as high as 2000-v ac.—Continental Sensing, Inc



Substation power transformer

24 • Internal tank bracing, central location of accessories in a locked cabinet at eye level give this transformer a streamlined appearance, lower maintenance. Standardized-design core-form transformer is available in all ASA standard ratings, from 750 to 10,000 kva, 3-phase, 69-kv and below.

Rounded-corner tank is lowered over core and coil assembly and welded at base. This allows core and coils to be bolted to base for rigidity, reduced untanking height and weight. —Westinghouse Electric Corporation

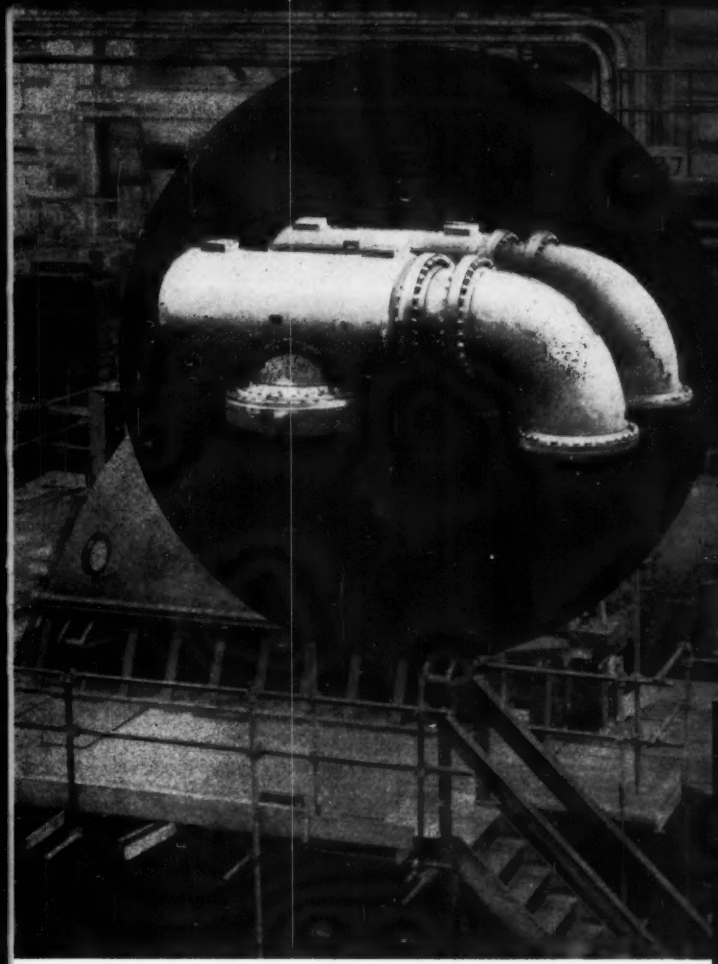
"Wear-in" compound

25 • Molybdenum disulfide compound is said to shorten wear-in period without use of abrasives; reduce galling, seizing and excessive wear. It doesn't need to be burnished into surface for maximum effect.—The Alpha-Molykote Corporation

Just circle key numbers on the Reader Service Card, page 102, to get complete product story

Hydraulic cylinder

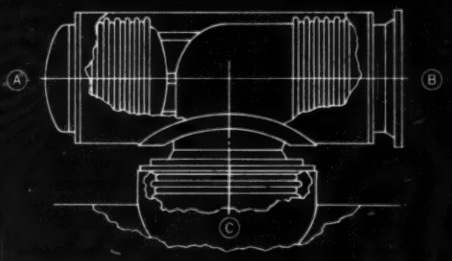
26 • Rated to deliver up to 385 tons of thrust, 14-in.-bore unit is designed for service at 3000 to 5000 psi. At



GIANT Turbine Expansion Joints Built by BADGER

Photo shows 150,000 kw steam turbine-generator unit undergoing tests prior to shipment at General Electric's Turbine-Generator Plant in Schenectady, N. Y. Badger Expansion Assembly is clearly visible atop turbine.

Badger balanced elbow expansion assembly.



Joint A balances thrust due to internal pressure of 65-150 psi; joint B absorbs axial movement; joint C absorbs the differential expansion between the inner and outer casings of the turbine. Assemblies range in size from 36 to 42 inches in diameter.

Custom engineered assemblies include many features of Badger S-R Design

750°F steam is flashed through these turbine crossovers at speeds up to 150 ft/sec and pressures up to 150 psi.

How do you protect piping and turbine casings from the stresses of extreme internal pressure and the expansion such temperature is bound to produce?

Working together, Badger and engineers at General Electric's Large Steam Turbine-Generator Department solved the problem with a new type pressure balanced elbow expansion assembly. Using two separate joints mounted in a T-shape casing (see diagram) the assembly effectively absorbs and controls axial movement. Although the device was custom engineered to General Electric's requirements, the bellows elements are constructed to the Curvilinear Corrugation design recently announced by Badger and now used in all S-R Expansion Joints.

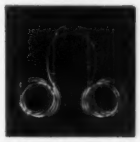
Whether you need standard S-R Expansion Joints or custom equipment, Badger can serve your needs. Get more information — write for illustrated brochure today.

New corrugation and ring designs produce better equalization, "all-curve" flexing

Curvilinear Corrugations used in S-R Expansion Joints were developed by the Badger Research Department. Under operating pressures (white line) the new design produces more uniform movement per corrugation and natural "all-curve" flexing. Stress is reduced . . . life increased.

Series 50 corrugation cross-section

S-R Joints for higher pressures have tubular Reinforcing Rings. These new rings make metal-to-metal contact only in the "valley" of each corrugation allowing natural "all-curve" flexing (white line). Tubular shape permits greater effective flexing height which contributes to longer life.



Series 150 corrugation and ring cross-section

BADGER

S R

SERVICE RATED

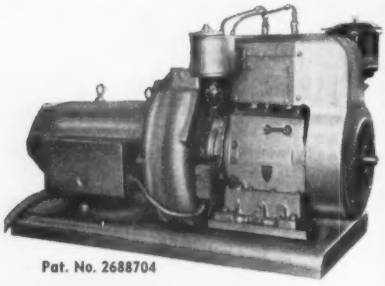
EXPANSION JOINTS

© 1958 BMC

BADGER MANUFACTURING COMPANY
230 Bent St., Cambridge 41, Mass. • 60 East 42nd St., New York, New York
Representatives in Principal Cities

NO DROOP DROP or BREAK

AMAZING U.S. MICRO-POWER



Pat. No. 2688704

SENSES...

. . . the slightest drop in voltage. Actually *anticipates* power failure BEFORE voltage drops below a usable level.

ACTS...

. . . automatically to guarantee absolutely uninterrupted power. Not one precious second lost in load transfers.

SAVES...

. . . UP TO $300 PER MILE on new Micro Wave installations. Just one compact Micro-Power Unit replaces a costly array of complicated equipment.

For Complete Information Write . . .

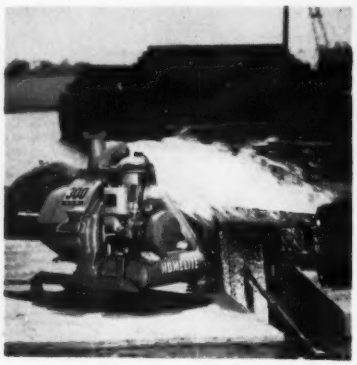
UNITED STATES MOTORS CORPORATION

102 W. FIFTH AVE. OSHKOSH, WISCONSIN

3000-psi rating for severe service operation, unit delivers 231 tons of thrust; it gives 385 tons at 5000 psi.

Said to be the largest and most powerful hydraulic cylinder offered at standard prices, unit makes possible price savings, faster delivery. —Miller Fluid Power Division

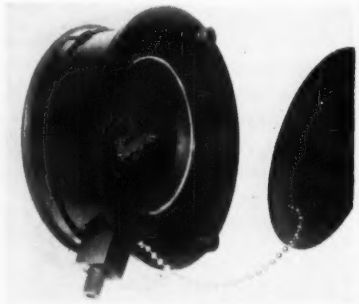
Just circle key numbers on the Reader Service Card, page 102, to get complete product story



Self-priming pumps

27 • Capacities to 18,000 gph are featured by 3-in. pumps. All-purpose units have rugged, 2-cycle engine design. The ceramic-coated seal, standard equipment on pumps, is said to last five times longer than iron-bronze seal; fifteen times longer under highly abrasive pumping conditions.

Self-cleaning construction permits handling muddy and sandy water without clogging. Units are guaranteed to pump and prime at 28 ft above water level.—Textron Inc, Homelite Div



Solid-front gage

28 • Positive protection of personnel is given with this gage. In case of tube failure, a full nylon back blows out at case pressures less than two psi; front shield is cast as an

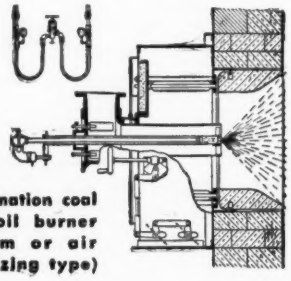
Enco OIL BURNERS

have these 7 ADVANTAGES in pulverized coal fired boilers . . .

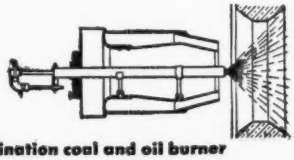
They may be installed in practically all types of pulverized coal burners, with these seven important advantages:

- They warm up cold furnaces
- They ignite pulverized coal—safely
- They assure continuous operation in case coal system fails
- They provide efficient and safe operation on bank and at low loads
- They respond almost instantly to sudden load changes
- They permit operation with oil or coal—whichever is available and lowest in cost per BTU.
- All capacities of steam, air or mechanical-atomizing types are interchangeable

The foregoing are only a few of the reasons why Enco oil-burners have been bought by a long list of leading industrial firms. Details of how Enco oil-burners can be adapted to your present pulverized coal burners will be gladly supplied—without obligation. Write The Engineer Company, 75 West St., New York, N. Y.



Combination coal and oil burner (Steam or air atomizing type)



Combination coal and oil burner (Mechanical atomizing type)

Enco Burners

ONE-SHOT "BOILER TREATMENT" GETS UNEXPECTED RESULTS

CEMENT MANUFACTURER SHOOTS THE WORKS!

CLEANING rotary cement-drying kilns by firing lead slugs into them to knock off accumulations inside is routine practice. The slugs go bounding and bouncing through the long drying kiln, doing a cleaning job equivalent to a whole crew of pick-and-shovel pilots. No one expects a slug to become so enthusiastic that it continues its chores inside the waste heat boiler attached to the far end of the kiln. In fact, the odds against getting a slug into the boiler *on purpose* are astronomical. But this one got there, odds and all, thus establishing a new type of one-shot boiler treatment which is hardly likely to become popular.

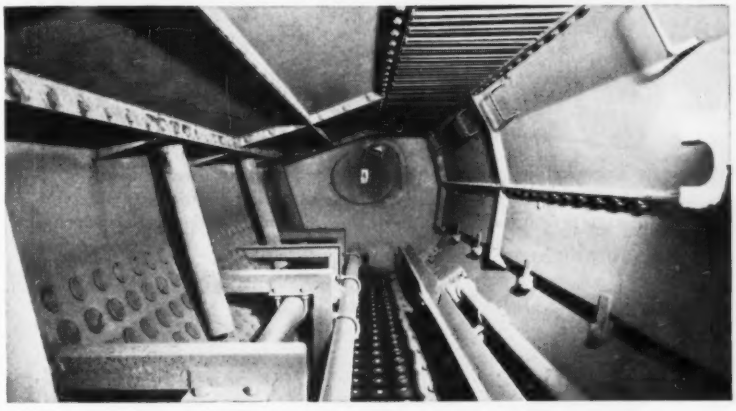
HOWEVER, *inside* the boilers at this large cement plant, Nalco System treatment helps make certain that boiler troubles, if any, are on the outside. Boiler feedwater is aerated, filtered, zeolite softened, evaporated and deaerated. A Nalco corrosion inhibitor is fed between deaerators and feed pumps for corrosion control throughout the steam and condensate return systems. Nalco catalyzed sodium sulfite does the oxygen scavenging on the discharge side of feed pumps. A Nalco internal treatment and caustic soda are fed directly into the boiler for pH control and scale prevention.

It is no wonder these boilers can turn out 169,000 lbs. of steam per hour, year after year, and stay like new—except, of course, for the wayward shotgun slug.

Nalco has not yet developed bullet proofing for boilers . . . But you can never tell what may come next! Meanwhile, we'll be happy to tell you more about effective Nalco Internal Treatment. Ask for Bulletin B1. National Aluminate Corporation, 6222 West 66th Place, Chicago 38, Illinois. In the Northwestern United States, Hawaii and Alaska: The Flox Company, Inc., Minneapolis, Minnesota. In Canada: Alchem Limited, Burlington, Ontario. Branches and affiliates in Spain, Germany and Italy.

THE TREATMENT: Lead slug, propelled by heavy powder charge in 8-gauge shell fired from a miniature cannon! "External treatment" with a vengeance.

THE RESULTS: "Plugged" boiler tube, pierced by lead slug on the pay off to one chance in a million. Internal treatment powerless here.



Steam drum in one of the Nalco-treated boilers at cement plant is typically clean and corrosion-free when opened for annual inspection.

Water treatment chemical mixing and proportioning room, where Nalco System treatment starts on its way to give complete steam system protection against scale and corrosion.

For more facts circle 279 on Reader Service Card, p 102

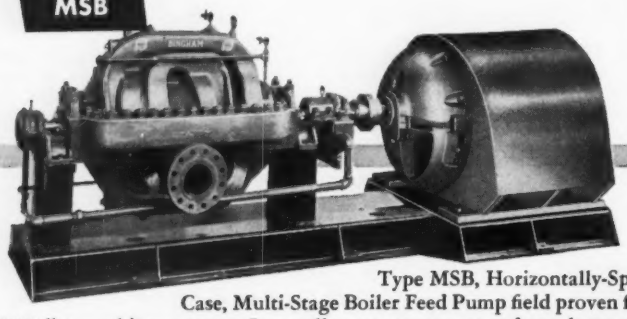
Specify

Bingham

"DOUBLE VOLUTE"
BOILER FEED PUMPS

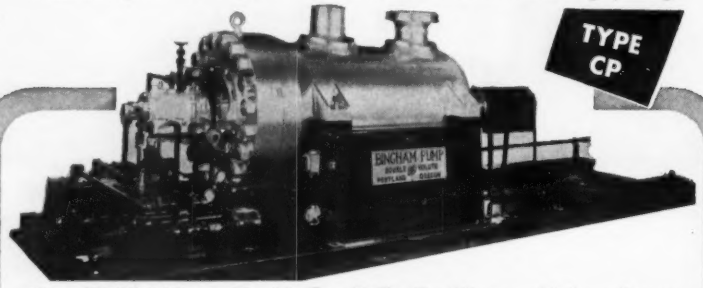
for the ultimate in dependability
IN HIGH PRESSURE SERVICE

TYPE MSB



Type MSB, Horizontally-Split Case, Multi-Stage Boiler Feed Pump field proven for 1200 lbs. working pressure. Integrally cast cross-overs and evenly spaced case bolting located uniformly close to the shaft center line, enclosing a minimum pressure area, eliminate case distortion and inter-stage jetting.

TYPE CP



Type CP, Multi-Stage, Double-Case Boiler Feed Pump with forged outer barrel for high pressure service.

All BINGHAM Boiler Feed Pumps feature: (1) "Double Volute" construction, resulting in full radial balance of the rotating element *throughout the entire operating range of the pump.* (2) Double suction first stage for low NPSH. (3) Balanced axial thrust (no balancing drums needed). (4) Kingsbury Thrust Bearings. (5) Stuffingboxes subjected to suction pressure only. (6) Design for High Speeds.

Bingham SINCE 1921

DOUBLE VOLUTE PUMPS RADIAL BALANCE

BINGHAM PUMP COMPANY
General Offices: 2800 N. W. Front Ave., Portland 10, Oregon
Factories: Portland, Ore. • Vancouver, B. C., Canada

SALES AND SERVICE OFFICES

Boston, Mass. — New York City, N. Y.
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Denver, Colo. — Seattle, Wash.
Houston, Texas — St. Louis, Mo.
Kansas City, Mo. — St. Paul, Minn.
Los Angeles, Calif. — Tulsa, Okla.
New Orleans, La. — Toronto, Ont., Can.
Vancouver, B. C., Canada

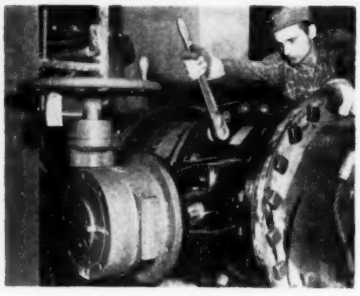
Equipment news

Begins on page 116

integral part of rigid case construction, cannot blow out. Full access is possible for easy adjustment. Movement is stainless steel.—Crosby Valve & Gage Company

Indicating controllers

29 • Stock delivery, minimum air usage, cartridge components, improved readability are features of compact "thin-line" temperature and pressure controllers. Units come in three temperature ranges — –25 to +375 F, and four pressure ranges —30-in.-hg vacuum to 350 psi. They are used with diaphragm-operated valves for gradual, accurate control. —The Powers Regulator Company



125-lb butterfly valves

30 • These butterfly valves are for service as replacement units, for pressure-reducing and throttling functions, for street shutoff, pump discharge, distribution systems.

Made to fit line sizes from 4 to 48 in., valves are lightweight and compact. They can be supported by the line, eliminating special construction. —B-I-F Industries, Inc

Just circle key numbers on the Reader Service Card, page 102, to get complete product story

LADISH

Controlled Quality

LIGHT WEIGHT
WELDING NECK
FORGED FLANGES
125 POUND

TO MARK PROGRESS

Reduce cost... eliminate breakage of cast flanged-end piping components when bolting to steel welding neck flanges

PIPING PROBLEM:

(1) Difficulty experienced in making pressure tight connection with flat face flanges with full face gaskets.

(2) Breakage of relatively brittle cast iron flanged ends on valves, pumps and other piping components when bolted to standard 1/16" raised face steel flanges.

LADISH SOLUTION:

The 125 pound Light Weight flange developed by Ladish is an ideal solution to this problem . . . for not only does it solve the problem . . . but it provides significant additional advantages of cutting purchase costs and reducing weight.

You can depend on Ladish for leadership in introducing piping developments to reduce cost and improve service.

A national network of distributors, Ladish plants and sales offices is ready to serve you.

Specification sheets on Light Weight Flanges and Welding Fittings available on request.

POSITIVE, LEAK-TIGHT JOINTS

Proven design principle of raised face flange has been adapted to assure a completely safe, positive connection to class 125 cast iron flat face flanges.

ELIMINATES NEED FOR HEAVY FLANGED ENDS ON VALVES AND PUMPS

No longer is it necessary to pay a premium to obtain the heavier flanged end valves, pumps and other piping components required to withstand bolting to raised face steel flanges in a welded piping system.

LOW WEIGHT—AMPLE STRENGTH

Light cross section design reduces weight to 30-50 per cent of ASA 150 pound Welding Neck Flange . . . still possesses ample strength to assure safe, leak-tight joint with mating cast flange.

LOWER COST

Savings in purchase price of Light Weight flanges are supplemented by additional savings realized by selecting valves on the basis of pressure rather than strength characteristic of flanged ends.

EASE OF INSTALLATION

Adequate welding neck type hub length keeps welding heats safely from flange. Prevents unpredictable warpage and deformation. Light weight facilitates handling, speeds positioning and installation.

MINIMIZES PIPEFITTER PRECAUTIONS

Safe and suitable for use with either carbon or alloy steel bolting . . . either full face or ring gaskets, in 1/16" or 1/8" thicknesses.

PRESSURE-TEMPERATURE RATING

Rating corresponds to ASA B16.1 class 125 cast iron flanges . . . 125 PSI (gauge) saturated steam; 175 PSI (gauge) water, oil or gas at 150° F.

SERVICE APPLICATIONS

Widely accepted for low pressure piping in gas distribution service . . . utility services such as water, heating, air conditioning, refrigeration . . . pumps and compressors.

TO MARK PROGRESS

LADISH CO.

CUDAHY (Milwaukee Suburb) WISCONSIN

SALES OFFICES: Amarillo • Atlanta • Baton Rouge • Buffalo • Calgary
Chicago • Cincinnati • Cleveland • Denver • Havana • Houston • Los Angeles
Mexico City • Montreal • New York • Odessa • Philadelphia • Pittsburgh
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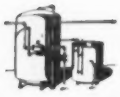
SAW BLADES • PIPE FITTINGS • DROP FORGINGS • RINGS • VALVES

LADISH...THE FITTINGS LINE THAT OFFERS COMPLETE SERVICE IN TYPES, SIZES AND MATERIAL SPECIFICATIONS

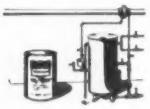
WELDING FITTINGS	ASA & MSS FLANGES	SCREWED & SOCKET FITTINGS & UNIONS	LONG NECKS	LARGE DIAMETER & T.E.M.A. FLANGES



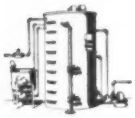
ZEOLITE WATER SOFTENER — manual and automatic. Up to 44% more soft water output from a softener of given size.

ULTRA-DEIONIZERS — produce highest quality mineral-free water. Replace distillation methods at fraction of distillation cost.

DEALKALIZATION & ION EXCHANGE SYSTEMS—Dealkalizers to control alkalinity. Ion Exchangers to produce water of any desired quality.

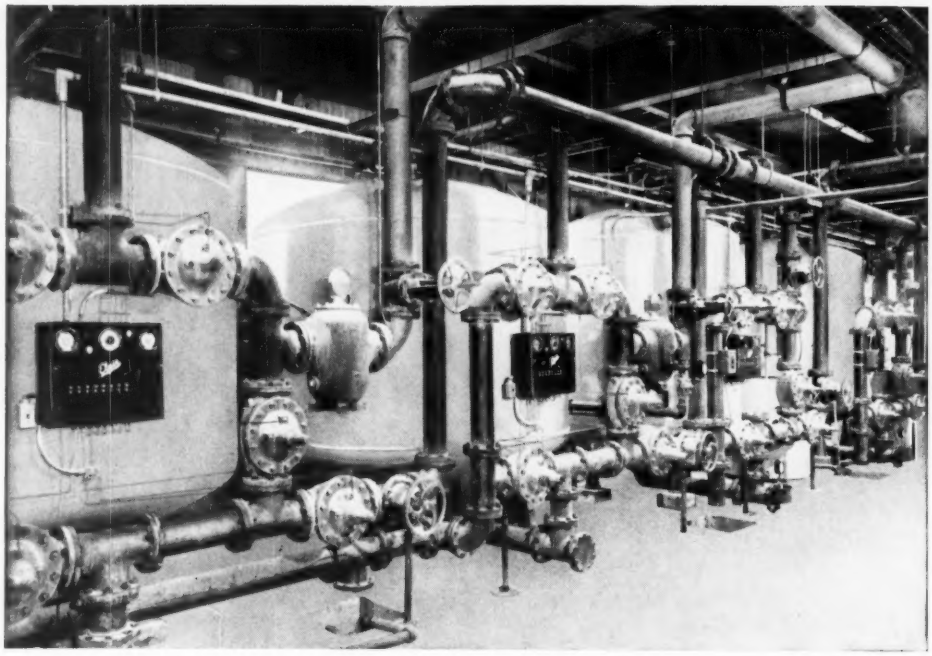


CHEMICAL TREATMENT SYSTEMS—prevent scale, corrosion and depositions with Elgin specially formulated chemicals.



CLARIFIER—for removing excess alkalinity and solids for clarification of turbid waters.

DEGASITORS—for removal of entrained gases from water by aeration.



Typical Elgin Automatic Deionizer

WHO IS QUALIFIED

To handle your water conditioning job?

Today's remarkable advances in water conditioning should suggest methods and equipment that can perform a profitable service for you . . . and this brings up the all-important question:

Who is best qualified to get right down to the practical job of putting these advanced methods to work for you under your specific conditions?

Certainly the best answers will be found in an organization like Elgin that knows and offers *every* modern and authoritative approach to *any* water conditioning problem.

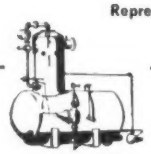
The scope of Elgin equipment and services is briefly touched upon here. To cover the full line would require many pages, but whatever your problem, Elgin with 50 years of intensive specialization is well qualified to solve it. No other organization is better equipped to determine your needs and meet them in the best and most economical way.

Your nearest Elgin Representative would like to put our fifty years of experience to work for you. Or, if you prefer, tell us your conditions and we will send covering bulletins.

ELGIN SOFTENER CORPORATION

130 No. Grove Avenue, Elgin, Illinois

Representatives in Principal Cities *In Canada: G. F. Sterne & Sons Ltd., Brantford*



DEAERATING HEATERS—supply make-up water pre-heated by exhaust steam in which CO_2 and oxygen are eliminated.

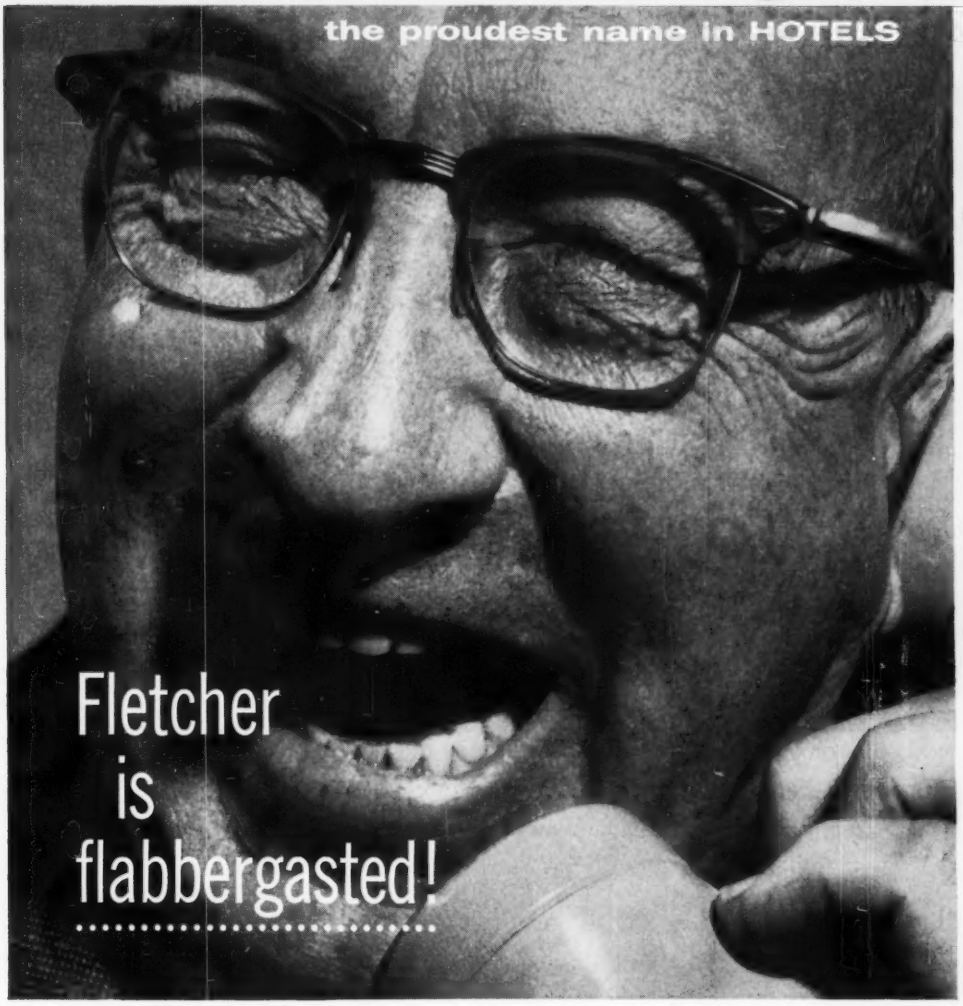
WATER FILTERS—Diatomite, sand, anthrafilt, activated carbon and oil removal filters in all types and sizes.

ELGIN WATER CONDITIONING SINCE 1908

For more facts circle 282 on Reader Service Card, p 102

SHERATON

the proudest name in HOTELS



Which of these 39 cities is your next stop?

EAST
NEW YORK
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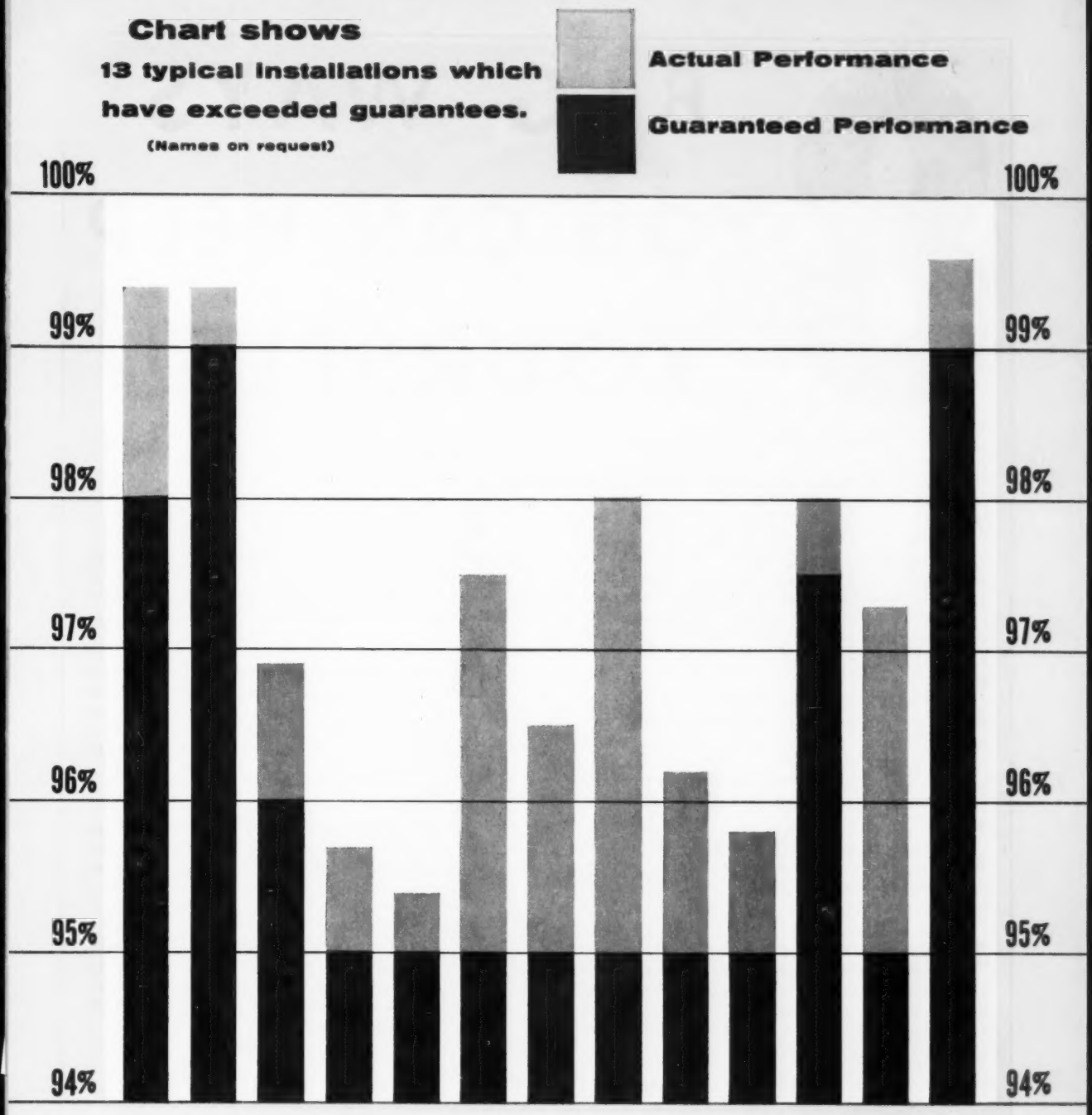
RESEARCH

Chart shows
13 typical installations which have exceeded guarantees.
(Names on request)



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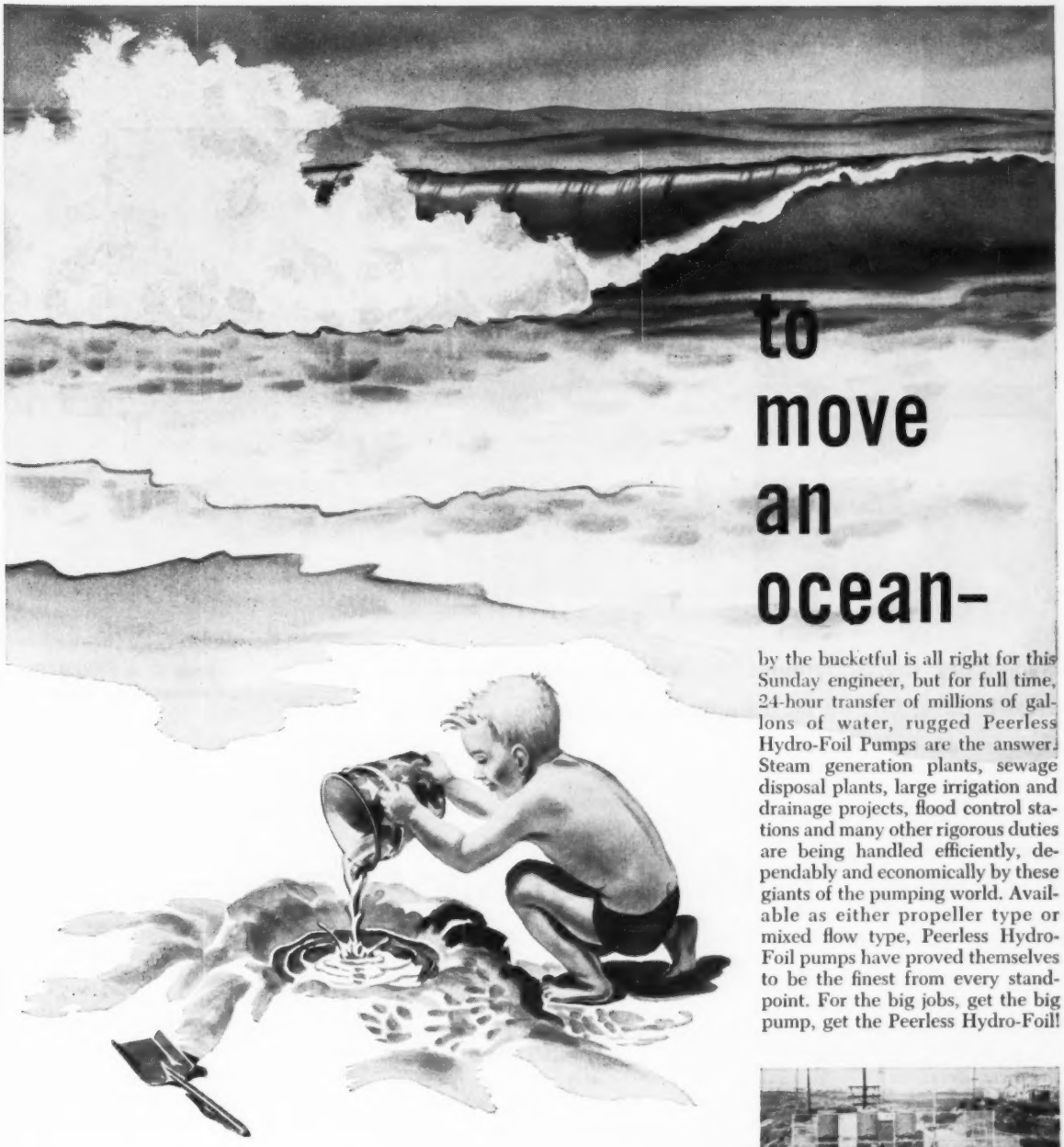

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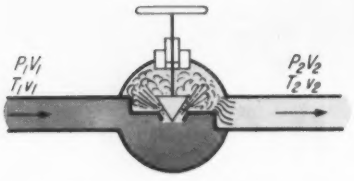
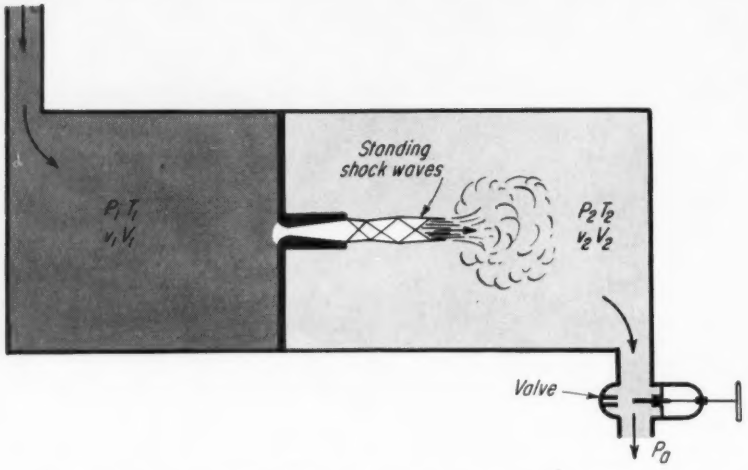
THERMO REFRESHER NO. 24



1 Throttling a gas or vapor flow reduces the downstream pressure, controls rate



2 Test setup for studying nozzle behavior receives gas at constant pressure P_1. Gas approaches nozzle at slow rate, speeds up in passing through opening to lower P_2

Elementary thermodynamic analysis of steady-flow processes is easy; but we must apply these principles cautiously because energy makes . . .

By B G A SKROTZKI
Associate Editor

Flowing fluids do strange tricks

We studied the basis of the steady-flow energy equation and learned how to apply it to some machines in a general overall way. We also quickly analyzed the energy relations of a gas blowing through a nozzle. Now let's look at a process that has some things in common with a nozzle, but an entirely different purpose.

Throttling. We throttle the flow of a gas or vapor primarily to control its rate of flow. This is done by making it flow through an opening smaller than the pipeline through which the fluid flows; a nozzle does essentially the same thing to produce a high-speed jet of fluid.

With a throttle we are not trying to reorganize the flow. Figure 1 shows a simple needle valve that can provide various sized annular openings for the fluid to pass through. Let's analyze what happens.

The fluid enters at a pressure P_1, a temperature of T_1 and a velocity of v_1. It leaves with a lower pressure P_2, a temperature of T_2 and a velocity of v_2. The change in velocity normally is small and can be ignored; there is no work or heat transferred during the process so we have no W or Q terms to deal with.

So shaking down our steady-flow energy equation:

$$\frac{wv_1^2}{2gJ} + H_1 + W_1 + Q_1 = \frac{wv_2^2}{2gJ} + H_2 + W_2 + Q_2 \qquad (1)$$

for the throttling process; $v_1 = v_2$ in most cases and both W and Q are zero so we have:

$$H_1 = H_2 \qquad (2)$$

Then if the fluid is a perfect gas with a constant specific heat, we find that:

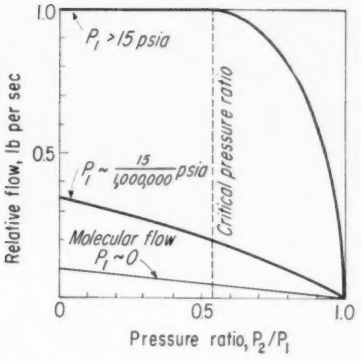
$$c_pT_1 = c_pT_2 \qquad (3)$$

which reduces to:

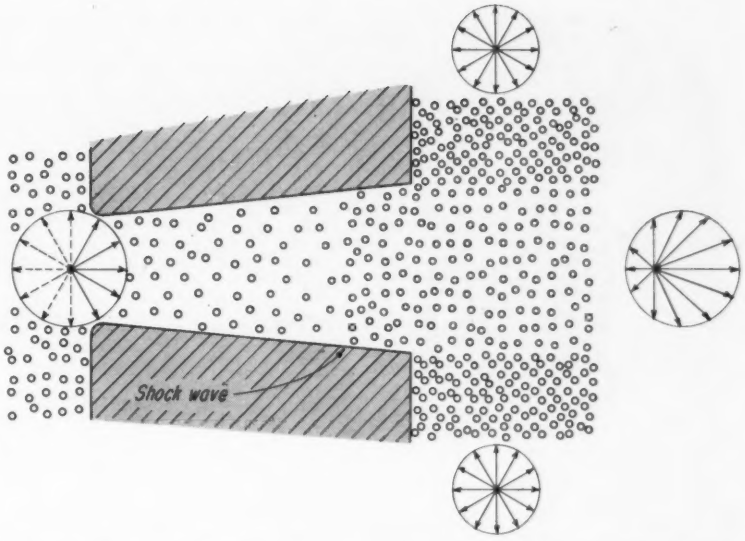
$$T_1 = T_2 \qquad (4)$$

This means that the temperature of a perfect gas does not change when throttled to a lower pressure. Actual gases do drop somewhat, depending on pressure and temperature level; we'll study this later in this refresher series. We'll deal only with perfect gases when theorizing.

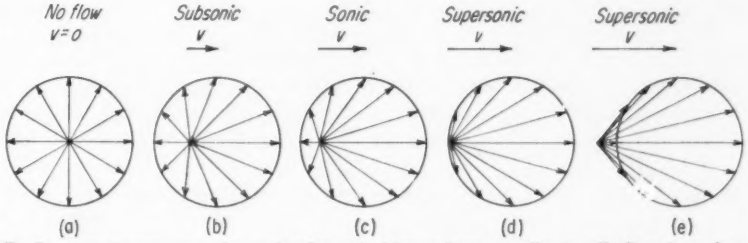
Constant temperature during throttling makes sense when we study the molecular kinetic theory. The root-mean-square average of the individual molecular velocities determines the temperature of the gas mass, see Part 6, Feb 1957, p 208. In passing through the throttle opening the molecules do not give up or acquire energy, so their average velocity stays constant. This means that the gas temperature must stay constant.



3 Rate of flow through nozzle depends on upstream pressure and pressure ratio



4 Molecules racing through nozzle at supersonic speeds catch up with molecules ahead grouped in higher density to form a shock wave that makes the overall flow slow up



5 In a stationary gas, the molecular velocities radiate equally in all directions, but when gas as a whole moves with speed v the molecular velocities become unequal

Remember, in a perfect gas we assume the molecules so far apart that their mutual gravitational attraction can be ignored. But at certain pressures they are close enough together so that when the gas expands part of the kinetic energy of the molecules does work against these attractive forces. This slows them down, meaning that their temperature drops. This explains the behavior of actual gases.

In the throttling process the gas pressure largely depends on the density D of the molecules in a given volume, where $D = 1/V$. Then $P = RDT$ and since both R and T stay constant during throttling the pressure depends only on gas density. In essence, the throttle holds back some of the molecules in the flow to vary the density.

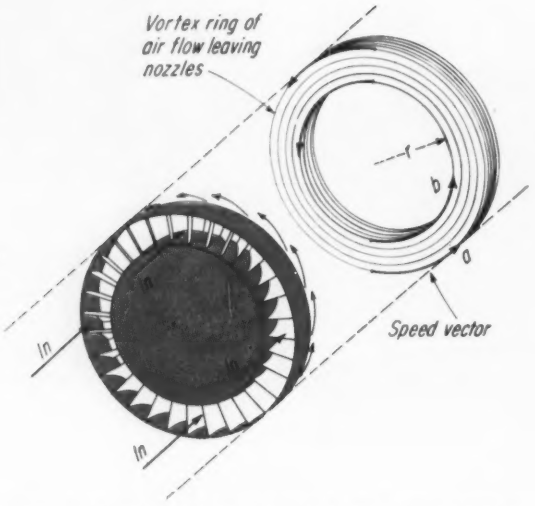
Nozzle flow. Figure 2 shows a schematic arrangement for testing the behavior of a gas flowing through a nozzle. A compressor (not shown) supplies air at *constant* pressure P_1 to a large chamber feeding the air to the nozzle under test. Air flowing through the nozzle discharges into a second large chamber held at a pressure P_2. From here the air flows to atmosphere through an outlet valve.

Closing the valve stops the air flow (assuming the supply compressor also stops) and the discharge pressure $P_2 = P_1$. As we gradually open the outlet valve the air flow increases through the nozzle. By keeping P_1 constant we find that P_2 will drop. By opening the valve more and more we increase the air flow as P_2 drops. But beyond a certain level of P_2 the air flow reaches a maximum and stays there no matter how far P_2 drops.

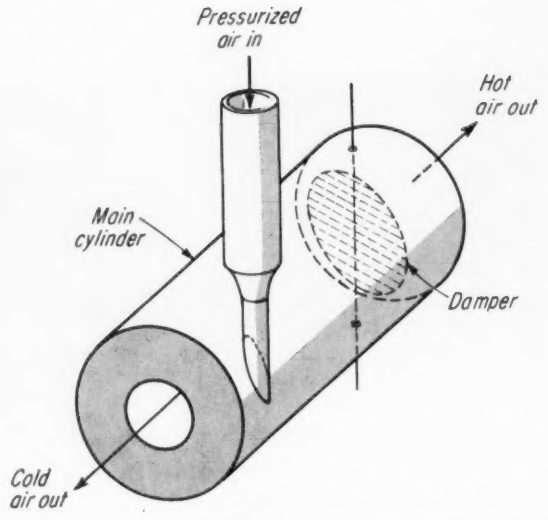
Figure 3 shows how the air flow varies as the ratio of P_2/P_1 changes. At about a *critical pressure ratio* of 0.53 the air flow reaches its peak. As the pressure ratio drops below critical (by dropping P_2) the flow does not increase. Instead, *shock waves* appear in the air flowing through the nozzle. Across these shock waves the air suddenly rises in pressure and density, changes temperature and drops in velocity.

This action seems to contradict expectations that flow ought to vary directly with pressure difference across the nozzle. We begin to approach this expectation when we put a vacuum pump at the test tank outlet and bleed air into the tank at the inlet at constant P_1. Figure 3 shows that the flow at very low pressures is nearly proportional to the pressure ratio. At molecular flows where the molecules do not collide with each other the flow is exactly proportional to pressure ratio. These low-pressure flows, however, do not ordinarily concern us in power equipment, so let's return to the pressure level we'll work with in practical applications.

Extreme crowding of the molecules in ordinary working gases makes the flows act in an unexpected fashion. Let's attempt to understand



6 Gas flowing through ring of nozzles in the turbine leaves as a vortex before entering the blades; the inner edge spins faster



7 In Ranque-Hilsch tube, air jet enters the main cylinder tangentially to form vortex that splits into hot and cold air jets

what happens to the molecules by a little speculation.

Molecular velocities. For future work we'll find the velocity of sound through quiet air of great importance. Many experiments and theory have shown it to be:

$$v_s = \sqrt{gkRT} \qquad (5)$$

At 59 F or 519 °R this works out to:

$$v_s = \sqrt{32.17 \times 1.4 \times 53.3 \times 519} = 1115 \text{ fps}$$

By comparison, the molecular kinetic theory shows the root-mean-square average speed at 519 °R to be 1635 fps for the individual molecules of air. A sound wave propagates through a mass of air at a speed less than that of the average molecular velocity, the ratio being:

$v_{mol}/v_s = 1635/1115 = 1.465$

In other words, the average speed of molecules is only 46.5% more than the speed of sound—a wave disturbance in the air.

In a quiet mass of gas we expect the direction of molecule travel to be equal in all directions, on the average. We could visualize this by a star of velocity vectors as in Fig. 5*a*.

If we can now set a mass of quiet air moving into a duct by using an impeller each molecule will have the overall velocity v added to it vectorially. Figure 5*b* shows the velocity distribution when the entire mass of gas moves with a subsonic velocity of v. This diagram suggests that about one-third of the molecules "backflow" against the general mass flow direction.

When we step up the gas mass to the sonic velocity in Fig. 5*c* about 25% of the molecules still backflow. At some supersonic velocity as in 5*d* or *e* all of the molecules flow in the generally forward direction. This rough analysis assumes that all of the molecules have the root-mean-square speed—the true situation is not that simple. Remember that molecular speeds in any mass of quiet gas vary from zero to more than three times the average, see Part 6, Feb 1957, p 89. This means that the spread of speed vectors is much broader in a gas flow than suggested by Fig. 5.

Nozzle molecular flow. In Fig. 4 we imagine the molecules of a gas near the mouth of the nozzle moving in all directions as suggested by the velocity vector star. For certain conditions only those molecules having a speed component in the direction of the nozzle mouth enter it and flow through to the low-pressure region.

For the condition assumed this could mean that the gas density in the nozzle is less than in the upstream chamber. The mass flow could be supersonic in speed—at some point in the nozzle or just beyond it the speeding molecules pile up abruptly forming a shock wave. The molecules still have their individual speeds that they exchange billions of times a second with each other, but there are more of them and the mass as a whole moves more slowly out of the nozzle into the lower-pressure area. Depending on the pressure ratio and temperature there may be several shock waves in the jet until it balances out to the discharge pressure P_2, see Fig. 2.

Vortex flow. The most important use of fluid flow through nozzles is in gas and steam turbines. The nozzles organize some of the random motion of the molecules into powerful jets that can exert mechanical forces.

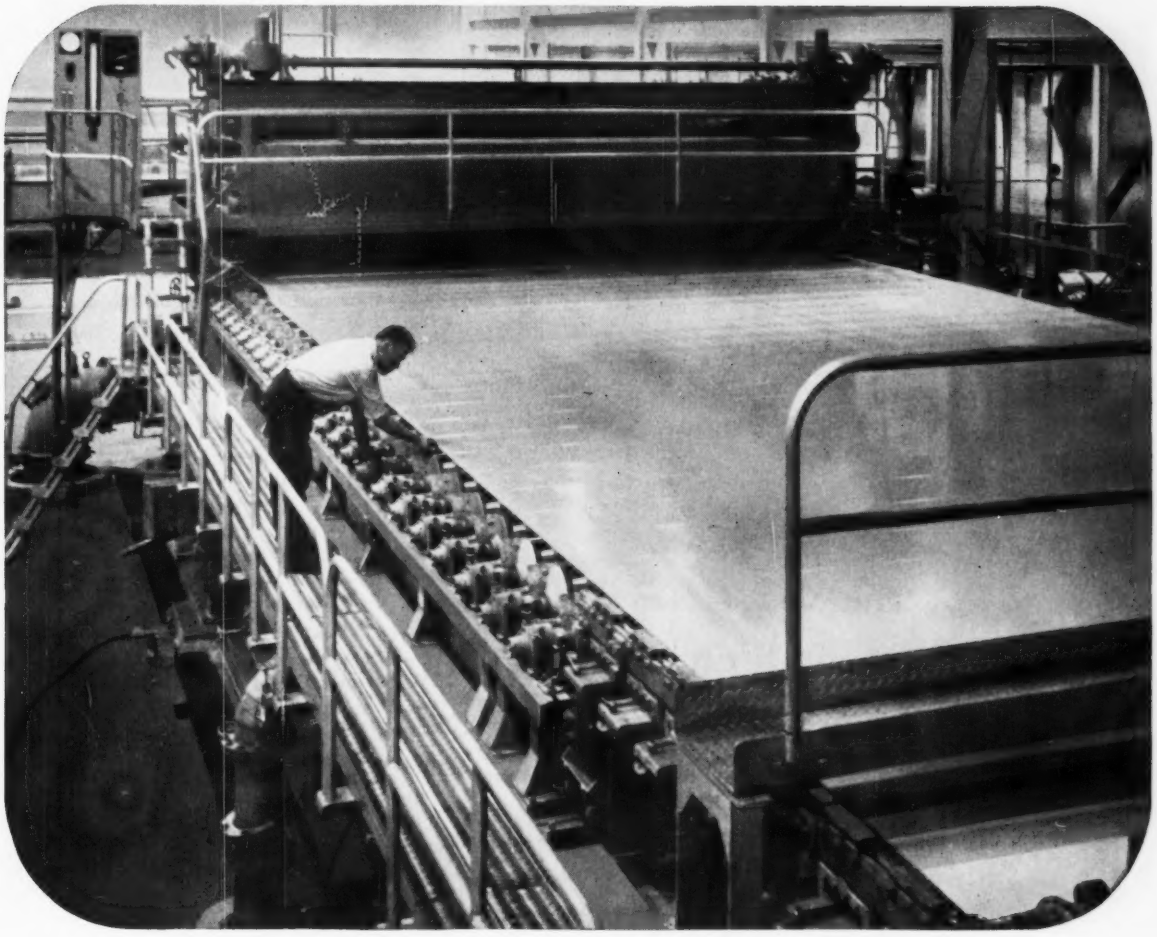
Figure 6 shows a simplified arrangement of a ring of nozzles in a stationary diaphragm receiving air flowing in an axial direction from the left. The nozzles direct this air flow into a series of jets that merge and spiral away toward the rotor buckets (not shown) in the direction of the arrows. This forms a *vortex* of air, shown separated to the right.

Whenever a fluid is forced to flow in a vortex the circumferential speed of the fluid varies—faster on the inner edge and slower on the outer edge. The basic law for vortex flow states that the product of the circumferential velocity and its radius from the center, r, must be constant throughout the ring of flow, or:

$$v_1 r_1 = v_2 r_2 = v_3 r_3 = \text{constant}$$

continued

ION EXCHANGE RESINS condition boiler feed



Wet end of Fourdrinier paper machine at a Minnesota and Ontario Paper Company Mill

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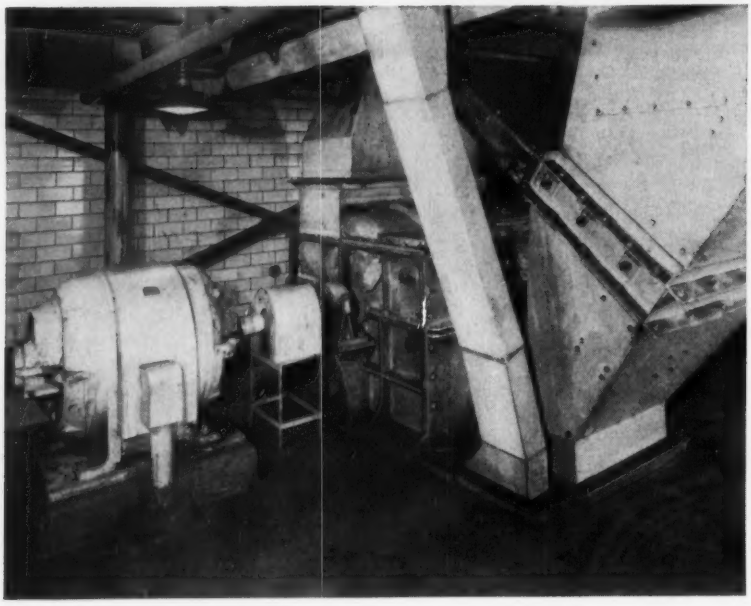

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Fluid flow

Continued from page 146

In Fig. 6, the arced vector *a* shows the distance a particle on the outer edge would travel while a particle on the inner edge would travel the longer distance *b* in the same time.

Ranque-Hilsch tube. The complex motion and energy relations of air are demonstrated by the Ranque-Hilsch tube. A Frenchman, Georges Ranque, received a basic U.S. Patent in March 1934 for the idea, and Rudolph Hilsch developed the tube further during World War II in Germany. Others are now developing it.

Figure 7 shows the simple arrangement of such a tube. A main cylinder receives a jet of air injected tangentially so the air stream is forced into a vortex flow. The vortex divides into two flows, so a stream of cold air can be withdrawn through a centered hole in a diaphragm in one end and a stream of hot air withdrawn from the other end past an adjustable damper.

The vortex flow takes place at slightly above atmospheric pressure in the cylinder. The damper seems to act primarily as a flow separator; both streams can leave from one end of the tube (as in the original Ranque tube), but the arrangement of Fig. 7 makes it easier to separate the flows.

Considerable experimentation has been and is going on in developing these tubes as sources of cold air, primarily for laboratory use. With pressurized air at 90 psia entering the nozzle about half the air can be taken out of the main cylinder at about 60-F colder and the other half at about 40-F hotter than entering air.

These few examples of actual behavior of gas flows show that a steady-flow energy analysis will not necessarily predict all of the results. To make a complete prediction or calculation we must use aerodynamic principles as well—but we will not cover these in this series.

Next part will deal with transient flows and introduce gas turbines—in a forthcoming issue.

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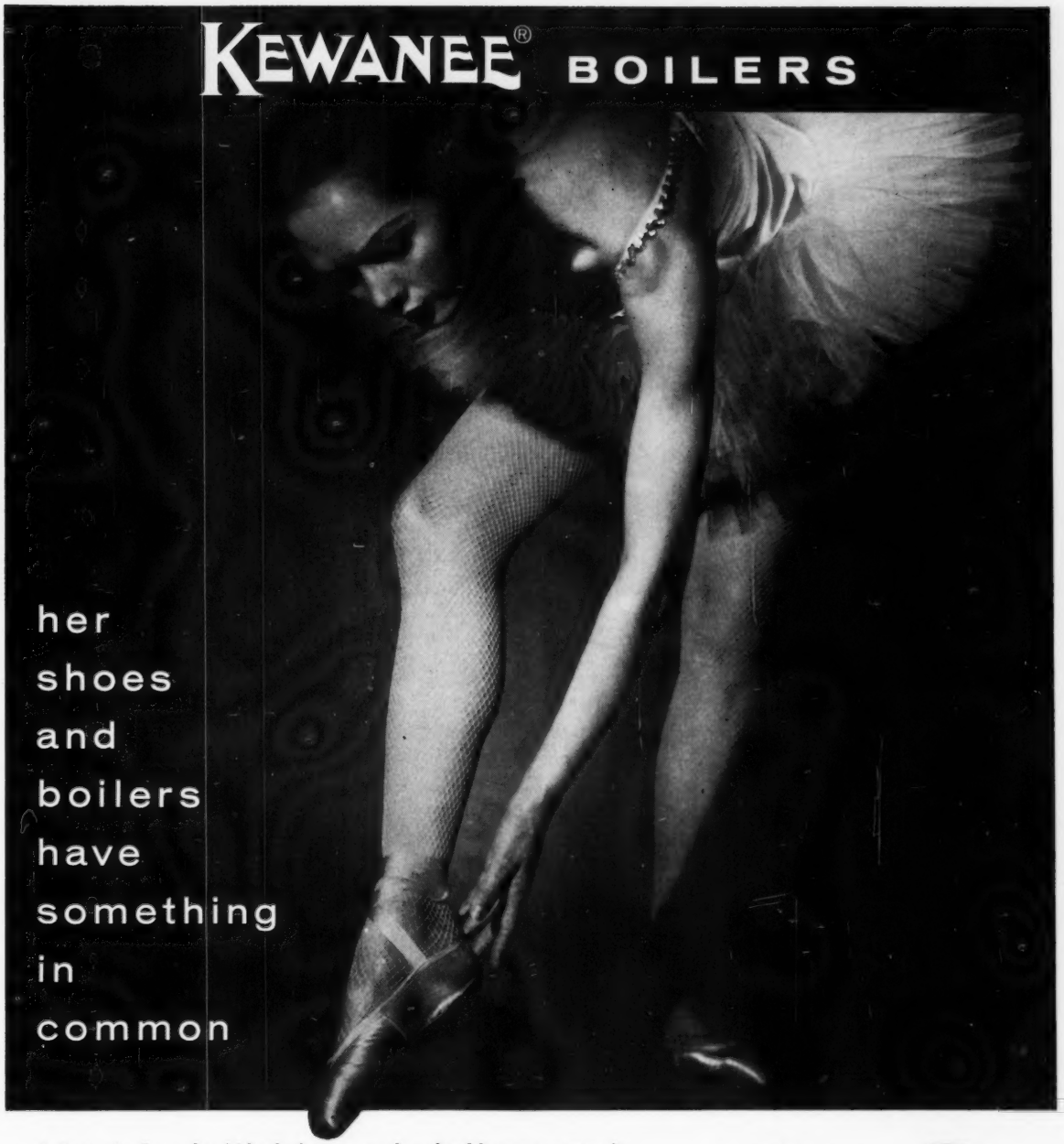

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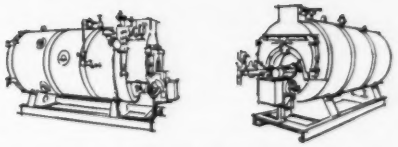

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"Skivvy Malone the crazy pumpman committed that accident red-handed and was given the deep six," Marmaduke Surfacelow roared out

Marmy's salt cure

Having lunch with interesting POWER readers in our roof dining room here in the big green building is one of the many pleasures of being a McGraw-Hill editor. Yesterday it was my good friend Carl Bachmann who dropped in. He is one of the busiest engineers I know.

Carl is an old friend of POWER. He's on the firing line for tracking down the numerous and varied problems that come up in some of the 300 busy Woolworth stores in the New York area. With over 4000 electric motors, refrigerators and the many air-conditioning systems, to say nothing of all the other equipment, it's a hot spot for a trouble shooter. For one thing, store managers don't want excuses; they want results—fast!

So I had Carl very much in mind this noon when I sidled up to Marmaduke Surfaceblow at the Bent Propeller Bar. The foxy consultant was leaning on the bar, staring at his bottle of Sandpaper Gin. As usual, he seemed to be grappling with some tremendous scientific problem. And, as usual, he was completely oblivious to the noisy chatter about him.

"How would you like to be nursemaid to several thousand motors and refrigerators?" I cautiously asked this world-renowned engineer. "And how would you . . ." But that's as far as I got with my questioning.

"BILGEWATER on refrigerators," roared Marmy in his foghorn voice, suddenly coming to life. "I'll tell you about the time I resurrected a diesel engine everyone had given up for dead, and all I used was a bucket of salt water and a piece of wire."

That did it. In no time all eyes focused on our hero. When Marmy sounds off, no one is foolish enough to butt in. So Marmy turned to his audience and blasted away.

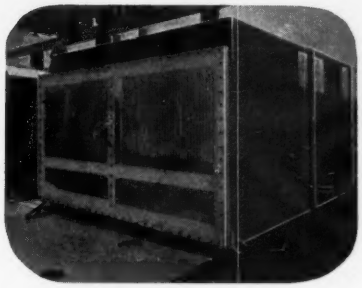
"Back in the winter of 1922 I was on the beach in San Francisco for a couple of months. I had been trying to sign on an Australia-bound Matson liner to see a little brunette in Sidney. She'd been writing me to show up in that down-under country for quite some time.

"So every time a Matson ship pulled in, I was in the port engineer's office looking for an engineer's berth. One Sunday, around midnight, the phone rang at my Embarcadero boarding house. The widow running the joint banged on my door, said the Matson's port engi-

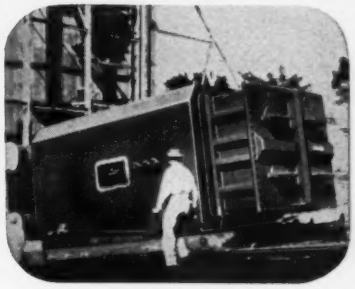
continued

and auxiliary equipment

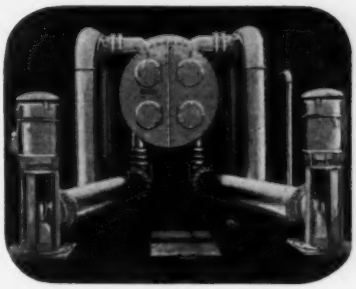
HOW C.H. WHEELER CONDENSER DESIGN saves space...



Head Room problems are solved by compact condensers like this one. Turbine floor to basement floor, in this case, is only 20 ft. The Unit has 65,000 square feet of condensing surface.

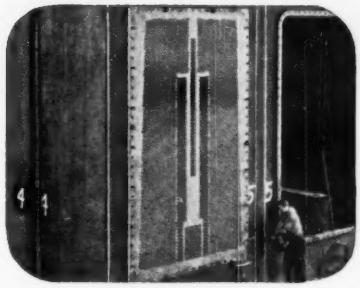


Rectangular Cross Section makes C.H. Wheeler Condensers adaptable to nearly any space or condenser arrangement because the length, width and height of any Wheeler Unit can be varied almost at will.

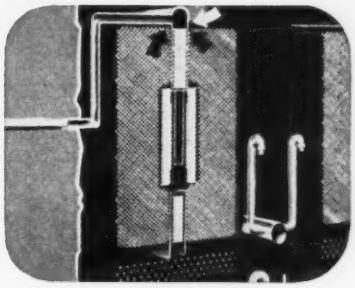


But Wheeler Doesn't limit itself to rectangular design. A round cross section worked out better here, for example, at the first planned gas-steam turbine station ever designed and built in United States.

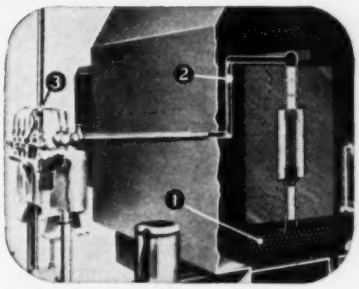
improves power generating efficiencies...



Triple Lane tube layout, another design feature, provides 3 pathways for steam travel, utilizes maximum cooling surface and produces higher condenser vacuums for power generating stations.

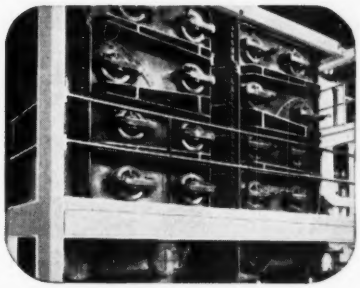


Location of air-vapor takeoff speeds steam travel and allows steam to penetrate to the peripheries of all tubes. It thus improves condenser efficiencies and overall power station operation as well.

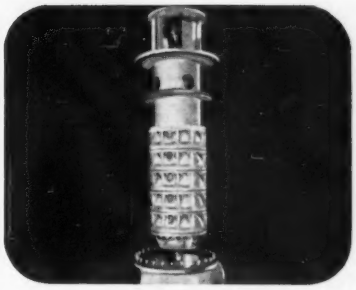


Deaeration of condensate not to exceed 0.01 cc. oxygen/liter is available with special Wheeler designs. Note the Deaerating Bars (1), the Air-Vapor Suction Line (2), and Tubejet® Ejectors (3).

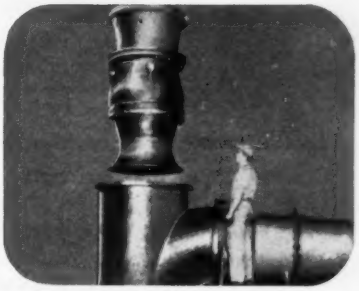
and reduces maintenance



Patented Reverse Flow permits flushing tubes and sheets without shutting down Unit, during full load with either or both circulating pumps operating. No additional circulating water inlet or discharge piping necessary with C.H. Wheeler's Reverse Flow.



"Pull-Out" Condensate Pumps simplify maintenance because entire pumping element, including all rotating parts, can be removed without disturbing either the pump barrel or the piping connections.



C. H. Wheeler Circulating Pumps, like Condensate Pumps, are easy to inspect and maintain because of "Pull-Out" design. In addition, shafts are heat treated alloy steel and impellers are statically and dynamically balanced for trouble-free operation.

C. H. Wheeler has been designing and building condensers since 1903; has developed such features as Dual Bank Design and Reverse Flow.

C. H. WHEELER MFG. CO.

19TH & LEHIGH AVENUE
Philadelphia 32, Pennsylvania

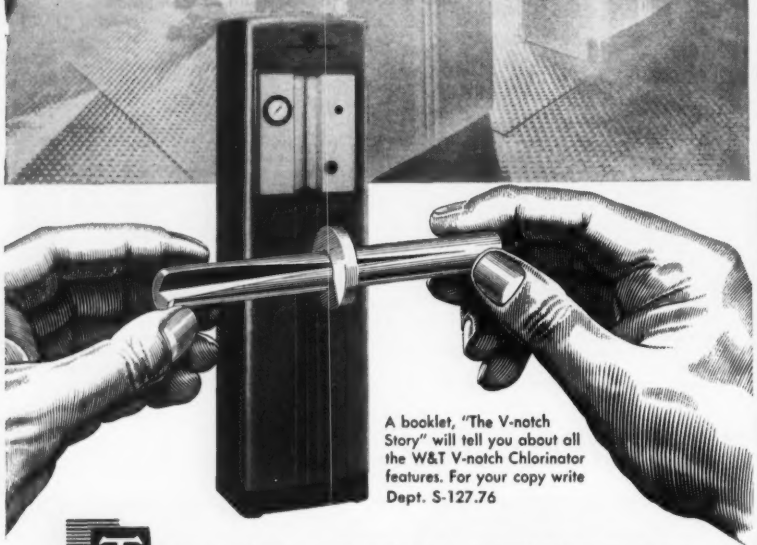
Whenever you see the name C. H. Wheeler on a product, you know it's a quality product

Steam Condensers • Steam Jet Vacuum Equipment • Centrifugal, Axial and Mixed Flow Pumps • Marine Auxiliary Machinery • Nuclear Products

For more facts circle 288 on Reader Service Card, p 102

the V-notch is the difference in chlorine control

Safe chlorine control is the job of a chlorinator.
This control, the V-notch, does the job completely.
Yet it appears to be simply a grooved plug in a ring.
It is, of course, more than that . . . much more.
The groove in the plug is precision milled and shaped so that when you turn the control knob on your chlorinator and the plug slides through the ring, the size of the opening between the groove and the ring changes an exact amount. You meter chlorine exactly and simply because every position of the plug in the ring makes a repeatable orifice size—a repeatable chlorine flow rate.
Only in a W&T V-notch Chlorinator is control so simple, so true, so precisely right.
And, of course, the right plastics make the whole chlorinator chlorine-proof.



A booklet, "The V-notch Story" will tell you about all the W&T V-notch Chlorinator features. For your copy write Dept. S-127.76

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25 MAIN STREET, BELLEVILLE 9, NEW JERSEY

W&T DRY CHEMICAL FEEDERS

For Accurate Feeding Of Water Treatment Chemicals

Full line of wide range dry chemical feeders capable of controlling a few ounces to 3000 lbs. per minute.

Write for Bulletin M-38 for complete Dry Feeder information.

WALLACE & TIERNAN INCORPORATED
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Marmaduke

Continued on page 150

neer wanted to speak to me, and fast.

" 'Here's your chance to pick up a few bucks, Mr Surfaceblow,' he yelled into my ear. 'The *Lauraline* is fueling alongside Pier 26. But the barge's crew hasn't been able to start their diesel-driven oil-transfer pump. Only the second assistant engineer is aboard the *Lauraline* and he can't help them either. My problem is that our ship is scheduled to sail for Honolulu at noon tomorrow. How about going down there and seeing what you can do?'

" 'Why don't you get the oil company to start their own pump?' I asked, a little burned up.

" 'Because,' he shot back, just as annoyed, 'it's Sunday night and I can't raise anyone in the oil company's office. Besides, everyone aboard the oil barge seems to be rummed up. And it's my responsibility to get that ship out at noon tomorrow—not the oil company's.'

" 'I'm not looking for chicken feed,' I told him. 'If I start that engine, I want to sail aboard the *Lauraline* as one of her engineers. I've got a big deal cooking down in Sidney.'

"He turned that around in his noggin for a few seconds, then barked, 'OK, you got me up the mast. I guess if you can get that boat out on schedule, no reason why I can't yank one of the engineers and put you aboard instead.'

"I reached the pier about one am. Soon as I got aboard the barge, her old captain came staggering out of the pilothouse towards me. His weather-beaten face was bruised—looked like he'd had a scrap with something besides a bottle.

" 'Where do you think you're going?' he yelled, doubling his fists. His barking brought a big bruiser of a bosun out of the galley. The uncorked neck of a bottle was sticking out of his peacoat. He was kinda wobbly himself.

" 'The port engineer sent me over here to start your transfer pump. Show me to your pump room,' I snapped, ready to sock him.

"That sobered the skipper a minute, then he busted out laughing. 'So you're gonna pump her out, eh?' he roared. 'You and who else? The *Lauraline's* second engineer couldn't start the engine. And our pumpman

A step up in safety...

BLAW-KNOX Electroforged® Steel Grating and Treads

Indoors or outdoors the safe way to build a walkway is with Blaw-Knox Electroforged steel grating. Nonslip twisted crossbar provides the safest possible surface. Self-cleaning, steel grating does not collect dirt or grease . . . provides maximum open area for light and ventilation.

Designed for flexibility, one-piece construction installs easily around beams, piping, machinery or other installations. Needs no maintenance . . . nothing to wear. All surfaces accessible for easy painting.

For more detailed information about how to order Blaw-Knox Electroforged steel grating and treads for your needs, send for your copy of Blaw-Knox Bulletin number 2527.

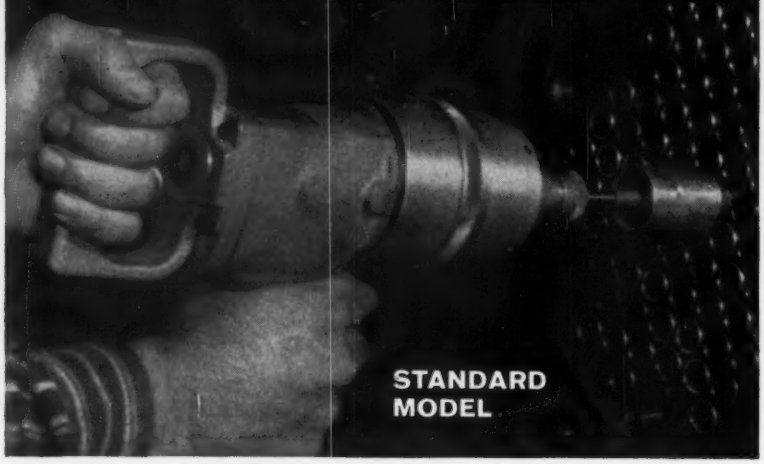
BLAW-KNOX

BLAW-KNOX COMPANY
Equipment Division
Dept. Y, Pittsburgh 38, Pennsylvania

For more facts circle 290 on Reader Service Card, p 102

ELLIOTT air magnetic tube expander drives

automatically controlled for fast, accurate tube rolling



Designed for faster, precision tube rolling, the standard model Elliott Air-Magnetic drive is setting new records for speed and accuracy. Some operators average 12 tubes per minute. Desired torque easily preset by rotating forward end of unit. No tools needed. Rolling stops when preset torque levels are reached. Includes trigger-controlled, explosion-proof air motor in single unit. Magnetic control, no springs. Balanced for easy handling. For tubes ¼ in. through 3 in. *Standard model* handles most jobs. *Heavy-duty* for higher torque.

ALSO Electric Control ... Tube Expanders ... and Related Accessories

Elliott offers the Automatic Electric Control—an accurate torque-limiting device designed for tube expanding with any standard tapping motor. Also, a complete line of tube expanders, with rotating, parallel, self-feeding rolls. Available in 4 sizes, ranging from ¼ in. to 3½ in. O.D.

Other related accessories include Elliott tube gage, tube plugs, tube pilot, and tube rolling lubricant.

Write for descriptive literature *today*.

Y9-3

ELLIOTT Company
LAGONDA PLANT, Springfield, Ohio

Marmaduke

Continued from page 156

monkeyed around with that diesel all day and couldn't even get it to sneeze. So now you're gonna start her? OK, I'll take you in tow.' With that he started amidships for the pump room ladderway. I followed.

"The pump room had a small 2-cylinder diesel. She was directly connected to a dc generator on one end. The big oil transfer pump on the other end was connected through a clutch. The engine's cooling - water pump was also driven by the engine, but through belting.

"I noticed that the engine had an electric starter hooked to her flywheel. And there was a large charging generator for the ampere-hour rated starting battery. But the engine's starting motor was smashed to little pieces. There were several sets of starting batteries scattered along the forward bulkhead.

"'What happened to the starting motor?' I asked the skipper, wondering what kind of a deal I'd let myself get talked into.

"'Happened?' he cackled. 'That didn't just happen, chief, that wreck was committed—and red-handed at that, by that crazy rumdum pumpman, Skivvy Malone, we had aboard. After he used up all those starting batteries trying to get the engine to turn over, he got sore and smashed that motor with a sledge hammer. We were doing a little drinking and I guess that rum went to his head when he couldn't start the engine. But my bosun and I took care of him. We threw him over the side.'

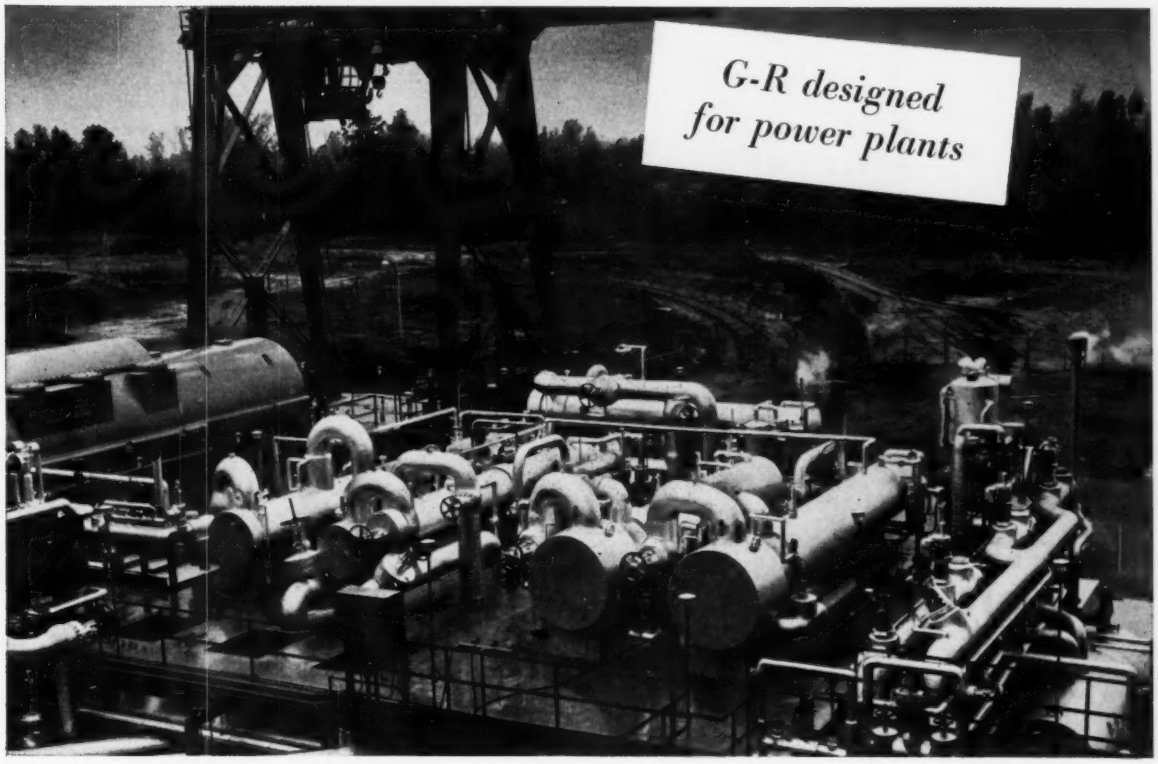
"Before I could say anything, he demanded. 'You say you're an engineer? OK, when ya gonna start pumping oil? The *Lauraline* hasta sail by noon.' He started laughing and rubbing his bruised chin.

"I'll admit, that stopped me cold. I stood there looking over that wreck. First I had to find a way to crank that engine over so she'd start firing. Then I'd have to find out why she hadn't fired and fix her so she would.

"Pulling off my coat I removed the injection nozzle from a cylinder and looked inside with my flashlight. There was a lot of moisture in her combustion chamber. That wouldn't help her fire, so I had to get rid of it.

"Just to be on the safe side, I checked the engine's crankcase for

For more facts circle 291 on Reader Service Card, p 102



Three reasons for specifying G-R Feedwater Heaters

SERVICE

Griscom-Russell service—from the design stage through installation to follow-up—is known to be the most complete in the industry. You *know* G-R Heaters will perform properly.

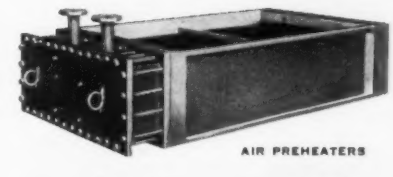
DESIGN AND CONSTRUCTION

90 years of experience plus extensive research contribute to the many *important* features that can be found in G-R Feedwater Heaters. Bundles are easily removable, steam baffling is designed for low pressure losses and efficient distribution, condensate drainage is complete without surging, capacity is guaranteed. These and other features provide the reliable operation and low maintenance that are inherent in G-R designs.

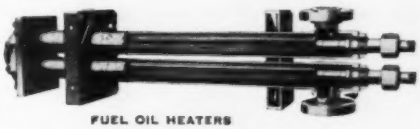
COST

Always competitive, frequently the lowest, always the most economical because you get more in service and lowered operating costs.

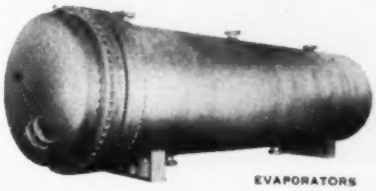
Send for Griscom-Russell Bulletin 300.



AIR PREHEATERS



FUEL OIL HEATERS



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THE GRISCOM-RUSSELL COMPANY • MASSILLON, OHIO

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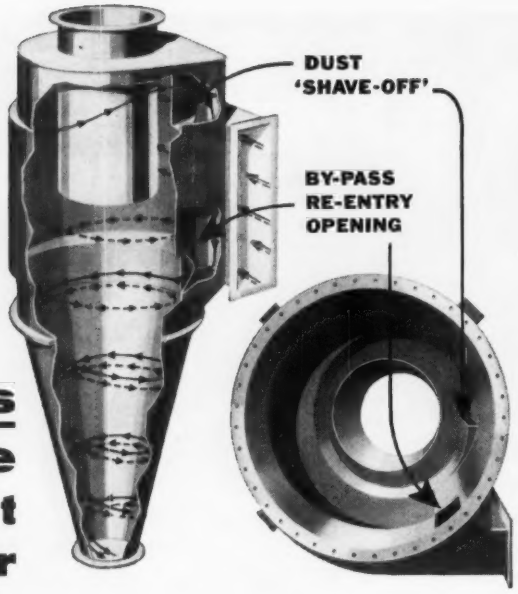
For more facts circle 292 on Reader Service Card, p 102

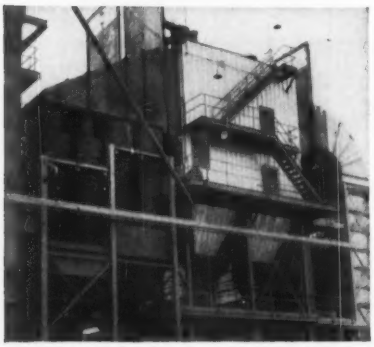


This Cyclone won't clog or plug

Buell's exclusive 'Shave-off' design permits large diameter cyclones that will not clog, plug, or bridge when properly operated: you avoid unnecessary maintenance work or process interruptions.

The unique Shave-off port traps the dust that whirls upward in double-eddy currents, increases cyclone efficiency by eliminating this source of dust reentrainment. Whether installed singly or in groups, Buell Cyclones are the most efficient ever developed.

Other features include extra heavy plate construction for longer service life, Buell-designed manifolds for more efficient, non-turbulent flow of dust-laden gases . . . and the confidence assured by a history of hundreds of installations everywhere in America. Write for a copy of the 12-page booklet, "The Exclusive Buell Cyclone": Dept. 50-B, Buell Engineering Company, Inc., 123 William St., New York 38.



Large-diameter Buell Cyclones in series with Buell 'SF' Electric Precipitator.

buell®

Experts at delivering Extra Efficiency in

DUST COLLECTION SYSTEMS

Marmaduke

Continued from page 158

lube contamination with water. I've seen jacket cooling-water leak into diesel cylinders, flood the crankcase and, finally, freeze the engine. But that wasn't the case here 'cause the lube oil wasn't diluted.

"I filled the two cylinders with diesel oil through the injection nozzle openings. Leaving the nozzles out, I cranked the engine with the hand-jacking lever to work most of the moisture and oil from her cylinders. That took care of that.

"The skipper just sat on the valve manifold, mumbling to himself. Every now and then he'd curse a blue streak, then start laughing.

" 'You shoulda seen Malone when the bosun and me fished him outa the drink. He had salt water running out of his ears,' he roared.

" 'Salt water?' I echoed, 'that's my answer. OK, skipper, I'll show you a better use for sea water than trying to drown someone. Get me a bucket of it and I'll have that pump running like crazy.'

"He looked at me dumbfounded, but got going. While he was gone, I looked around for some wire to use as a starting resistor in that brine.

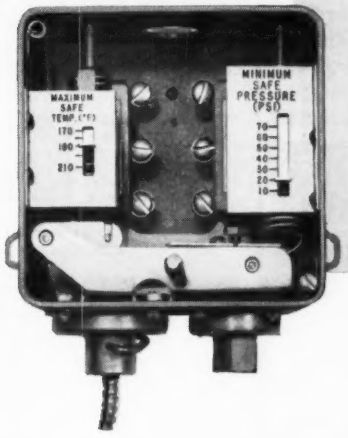
"When the skipper returned with the water, I went into action. In no time I motorized the direct-connected generator and hooked up my homemade starting resistor. All I needed was a dc source to energize the motorized generator.

"FLASH, I had it. Every oil barge had an emergency lighting system hooked up to a few batteries. So I asked the skipper to lead me to his. The bos'n helped me lug back the batteries, and I hooked them to the motorized generator.

"After a few minutes the motorized generator was cranking over the engine. A couple of revs later, when all the moisture and fuel oil was expelled, I stopped her. Then I screwed in the injection nozzles and started her again. Soon as she started rolling, I put her on fuel. That old girl suddenly started coughing and sputtering, then burst into a full roar. Finally, she settled down to purring like a well-fed kitten.

"The skipper's eyes bulged from their sockets in disbelief. I was a little surprised myself, especially after looking at that smashed-up starting

Temperature and pressure set points are inside the case, protected against accidental manipulation. Cover is removed for easy adjustment.



New Diesel engine safety switch

...gives fail-safe protection

This all-new Honeywell safety switch responds to abnormal pressure or temperature to stop or idle a diesel engine, or actuate an alarm circuit.

It combines separate systems for measuring engine coolant temperature and lubricating oil pressure. The temperature system includes an exclusive fail-safe feature, so that in case of damage to its temperature bulb, capillary or diaphragm, the switch responds as it would to excessive temperature.

Temperature and pressure settings can't drift off set points. There can be no false shutdowns due to vibration. Set points are easily adjustable in the field.

Your nearby Honeywell field engineer will be glad to give you complete information about the new Diesel Engine Safety Switch. Call him today . . . he's near as your phone.

MINNEAPOLIS-HONEYWELL, Wayne and Windrim Avenues, Philadelphia 44, Pa.

REFERENCE DATA: Write for Specification sheet S1010-5 "Diesel Engine Safety Switch."

Honeywell

H HONEYWELL *First in Control*

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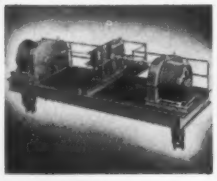
Murco GATE HOISTS

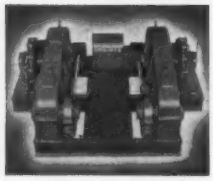
. . . TO CONTROL WATER LEVEL at LONG SAULT DAM, ST. LAWRENCE PROJECT

Each hoist weighs 93,000 lbs., shipped completely equipped with all electric motors, controls, limit switches, wired ready for operation . . . the overall length of one unit is 57 feet, 8½ feet wide, 12½ feet high . . . with a lifting capacity of 175 tons . . . will raise and lower the gates in the dam at a speed of 1 foot per minute.

MURCO GATE HOISTS . . . FOR ANY SIZE POWER DAM

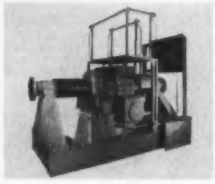
Capacities from less than 1 ton to over 100 tons.





From the smallest hand operated to the largest motor operated Gate Hoist.

Backed by over 75 years experience in design and manufacture.



Write for complete information and Engineering Department recommendations.

D. J. MURRAY MANUFACTURING CO.

MANUFACTURERS SINCE 1883

WAUSAU • WISCONSIN

Marmaduke

Continued from page 160

motor scattered around the steel deck and all those dead batteries.

"Going topside for air, I found the *Lauraline's* fueling crew crowding her railing, attracted by the diesel's noise. At long last, oil was being pumped aboard, so I was sure she'd sail on time.

"Next morning at 8 o'clock the widow knocked on my door again. She said the port engineer wanted me on the phone.

" 'Pack your bag, Mr Surfaceblow, and get aboard the *Lauraline* soon as you can. You're her new first assistant engineer,' he yelled. Then he added, 'I went aboard the barge this morning to find out why they couldn't start that pump. And believe me, any guy who could get that wreck started has the right to call himself an engineer. We need men like you on our ships.'

"Four weeks later I was in Sidney. So my success as a trouble-shooter really paid off."—SME.

Marmy's Mailbox

DOESN'T AGREE

In Feb '58, "Marmy's Big Bust," he filled the main engine with bottles of Scotch and pulled the throttle wide open. I spent 23 years at sea and know that no engineer would yank the throttle wide open without first warming up the engine.

J A SMITHSON, *Vivian, La.*

MARMY'S NOTE: *Bilgewater on warming up the engine. If the cylinders are full of Scotch, the boiler inspector breathing down your back and the customs inspectors eyeing you—what would you do? By pulling the throttle I saved my license and kept out of jail at the same time.*

TRUE TO LIFE

Marmaduke's unusual experiences with their common sense solutions are certainly true to life.

R E MILLER, *New York City*

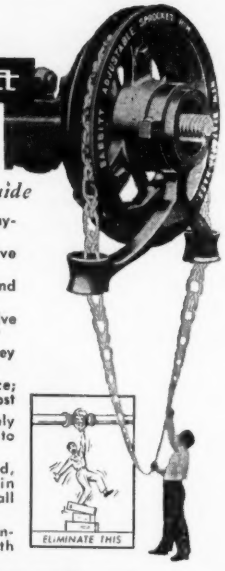
MARMY SHOULD SPARK MORE

Thanks for the pleasure I have each month with POWER's Marmaduke. But why doesn't Marmy tell more stories about the electrical problems he's solved?

R P CHAUVET, *Kirkuk, Iraq*

Safe Operation of Overhead Valves

with a Babbitt Adjustable SPROCKET RIM with Chain Guide



- Simplifies pipe lay-out
- Fits any size valve wheel
- Easy to install and operate
- Operates any valve from plant floor
- Time and money saving fixture
- No maintenance; first cost only cost
- Packed, completely assembled, one to a carton
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circle 297 on Reader Service Card, p 102 ➤

BERGEN GETS 8 LJUNGSTROMS®
...AND SOME REMARKABLE CUSTOMER SERVICE

Public Service's new Bergen Generating Station will be served by 8 large, horizontal Ljungstroms. Almost as important . . . the Ljungstroms will be serviced *throughout* their life by Air Preheater.

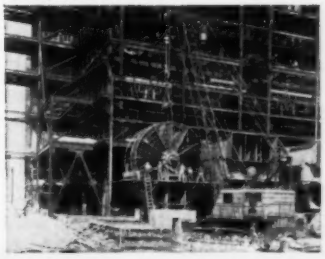
What's special about this customer service? For one thing, it's the considerable knowledge and talents of Air Preheater's engineers. They have been involved in nearly every conceivable type of boiler/preheater problem. They've seen how these problems can be handled. And they can put this experience to work for operators of Ljungstrom air preheaters.

Your Air Preheater engineer also makes regular calls to check the operation of every Ljungstrom – for as long as it's in service. (This now includes installations dating back to 1923.)

So, when you select a Ljungstrom, you're never entirely on your own. You *continue* to be the responsibility of a competent Ljungstrom engineer and benefit from his experience and knowledge. Maybe that's why 9 out of 10 preheaters sold are Ljungstroms.

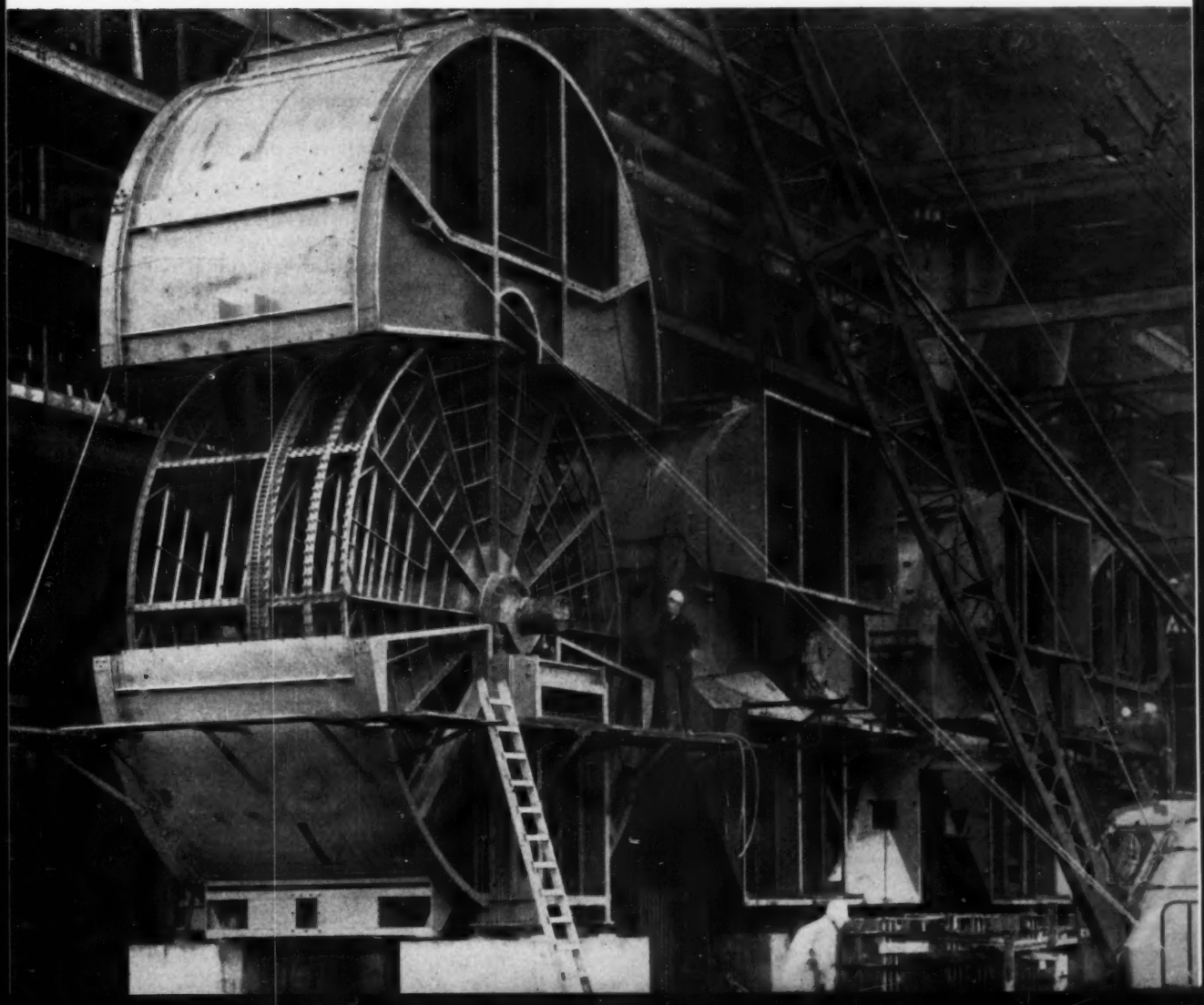
Thirty-five tons of Ljungstrom rotor being lowered into place at the new Bergen Generating Station at Ridgefield, N. J. (When the heating elements are installed the rotor will weigh 150 tons.) This is one of eight preheaters being installed by Public Service Electric and Gas Co. to serve two boilers – each evaporating 1,900,000 lbs of steam/hr. The first boiler is to be fired early next year. Anticipated preheater outlet temperature is about 275 F.

Public Service is one of the first Northern utilities to use large-size horizontal preheaters. They have nine such horizontals in operation at their Linden Generating Station and have ordered eight more for their new Mercer Generating Station.



THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.



Powerscope . . . A selective look at

More fresh water from the sea

New era in man's perennial efforts to convert sea water to fresh water may be in the offing. Southern California Edison Co has awarded a contract to Cleaver-Brooks Special Products, Inc, to provide evaporation equipment for a pilot conversion plant. Demonstration unit, to be operated in conjunction with existing steam-generation facilities, is first of its kind in the country. New equipment will use flash evaporation.

Soviet Union lags behind U.S. in industrial water-treatment technology. That's the sum of a technical paper by V J Calise and W A Homer, Graver Water Conditioning Co. The paper—a survey of water-treatment practices in Russia and Eastern Europe—shows that many of processes used by Russians are hangovers from the 1930's and '40's and cost hampers adoption of newer techniques.

Cleaner streams and development of robot monitors to maintain a continuous check on their cleanliness are forecast in annual report of Ohio River Valley Water Sanitation Commission. With regard to industrial-waste discharges into streams, the report shows that three-quarters of plants in the Ohio Valley are operating facilities to curb pollution. Number now rated as having adequate control facilities is double that of five years ago. Pioneer work is continuing on water-quality monitoring program and in application of automatic equipment for this purpose. Goal: Operation of 24-hr-a-day sentinels on Ohio River that will alert state agencies on changes in river conditions.

From wires of McGraw-Hill World News

Bonn: A Polish 15-year plan calls for completion of nuclear power plants totaling 700 mw by 1975. Largest Polish nuclear plant to date is in Miechowice, reportedly has 220 mw.

Milan: Technicians of Czechoslovak CKD Works have come out with small low-cost hydroelectric plants producing 20 to 300 kw for lower heads, smaller water quantities.

Vienna: By 1965 the Soviet Union will have more than 20 thermal power stations with capacity of 1 to 2 million kw each, reports *Izvestia*. Thermal stations to 2.4 million kw are in design stage.

Bonn: One of largest hydroelectric plants in Europe is nearing completion at Ybbs-Persenbeug on the Danube. First proposed in 1924, the plant has fallen victim to war and political stress, but is now scheduled for full-scale operation in the fall of 1960. Soon to be added to present equipment are six vertical-shaft turbine-generators, each consisting of a 45,000 kva generator and a 43,900-hp 340-ft-head kaplan reaction type turbine.

Paris: Private power companies in Euratom countries can now team up with state-owned Electricite de France (EDF) to build nuclear power plants in France. New law makes it possible to set up French corporation in which EDF must hold at least half of the stock. Remaining stock participation must come from corporations or nationals of Euratom countries. EDF will operate plants built under new scheme. Power produced will be split up in same ratio as stock holdings; foreign companies' share will be delivered over EDF transmission system to appropriate fontier.

Tokyo: Peking radio says a 220-kv oil-filled power cable has been made for the first time in China. Problem now: How long will it take for Red China to manufacture enough power cables to fill vast present needs?

Plucked from AIEE Winter Meeting

A twist on moonlighting—turning playtime to studytime—holds answer for trainees in electrical maintenance program at Dow Chemical Co, Midland, Mich. All students are expected to put in about as much study outside of the plant as in class. Under training agreement with union anyone failing to achieve a grade of at least 75% in each course must leave the maintenance dept.

Dc overhead transmission will not be used economically to any extent in the U.S., report three GE engineers. They point out a minimum of about 350 miles is required to overcome economic advantage of presently available ac systems. Advantages of dc transmission were listed as lower line costs, flexibility of an asychronous tie, high circuit loadings possible. Ac advantages are probable lower terminal equipment costs, inherent flexibility, proven reliability of ac systems and equipment.

New grease-like silicon compound on line insulators in electrical systems may prove key to preventing fires and flashovers. Still in experimental stage, compound is wiped onto insulators with a cloth. One application is expected to last two to three years.

this month's power-field happenings

ART SOMMER, Assistant Editor

Troubles mount in LA's smog fight

Last month we reported on Los Angeles' new Rule 62 which forbids burning of fuel oil in that city during the smog season, but it now seems . . .

Automobiles, not industrials, are major cause of LA's smog woes. City's fight against smog took a new turn when council introduced a resolution asking the legislature to enact a law prohibiting the sale of automobiles in California unless they have smog-prevention equipment. Proposed ban would go into effect Jan 1, 1961, with a 2-yr grace for owners of old cars to install equipment.

Adding more muscle

Sale of eight heat reclaimers for world's largest heat reclamation installation at Cannon Mills, Kannapolis, N. C., was announced by Patterson-Kelley Co. Designed to recover heat from waste water and dry liquors, the eight units together will process 3000 gpm of waste hot water to heat an equal amount of fresh water through temperature rises of 60 to 130 F.

New Allis-Chalmers 75,000-kw steam turbine-generator—largest in northern Wisconsin—is now operating at Wisconsin Public Service Corp's Pulliam Plant, Green Bay. Steam conditions for the modern reheat-tandem, 3600-rpm unit are 1450 psig, 1000/1000 F and 1.0 in. Hg abs. The unit ups plant capacity to 267,500 kw.

Gas-insulated power transformer rated 10,000 kva —highest capacity yet built—will step down 69,000-volt power to 12,470 volts in Pennsylvania P&L Co's Allentown outdoor sub. GE built the unit.

Ratio of utility-installed capacitor kilovars to peak-load kilowatts in U.S. increased from .38 at end of 1957 to .40 at end of 1958, according to GE's W G Hart. He points out that 1958 saw capacitor prices cut to an average of $4 to $6 per installed kilovar. Based on current prices, Hart says capacitors will yield investment return of about 40% in terms of loss reduction alone.

Side glances at the power scene

Baseball's hot-stove league is in mid-season, and San Francisco's Giants feel they have the formula for catching Milwaukee's champion Braves. At a recent conference between the board of directors of the baseball Giants, the architect and consulting engineers, the engineer was being questioned about various equipment he'd laid out and specified for the Giants' new stadium. He noted that the boilers were made by Cleaver-Brooks Company of Milwaukee. Immediately Giant prexy, Horace Stoneham, wanted to know if boilers couldn't be obtained from some other place in the U.S. besides Milwaukee. Whole matter was resolved when sales agent was requested to furnish an affidavit to effect that the Giants will finish ahead of Braves in the 1959 Pennant race.

Fire-explosion warning device, developed by Minneapolis-Honeywell Regulator Co's research center, signals not only actual fire but smoke, vapors too. It's first warning device sensitive to all three, says Honeywell.

Meeting foreign competition, GE will supply Tata Chemicals, Ltd of Mithapur, India with nearly $200,000 worth of electric motors and controls for addition to Tata's existing facilities.

Unique feature of Westinghouse supercritical pressure turbine element being built for Cleveland Electric Illuminating Co, is that it will be made from a ferritic rather than an austenitic steel alloy. Steam inlet conditions of 3500 psig at 1100 F with reheating at 1050 F were selected after study.

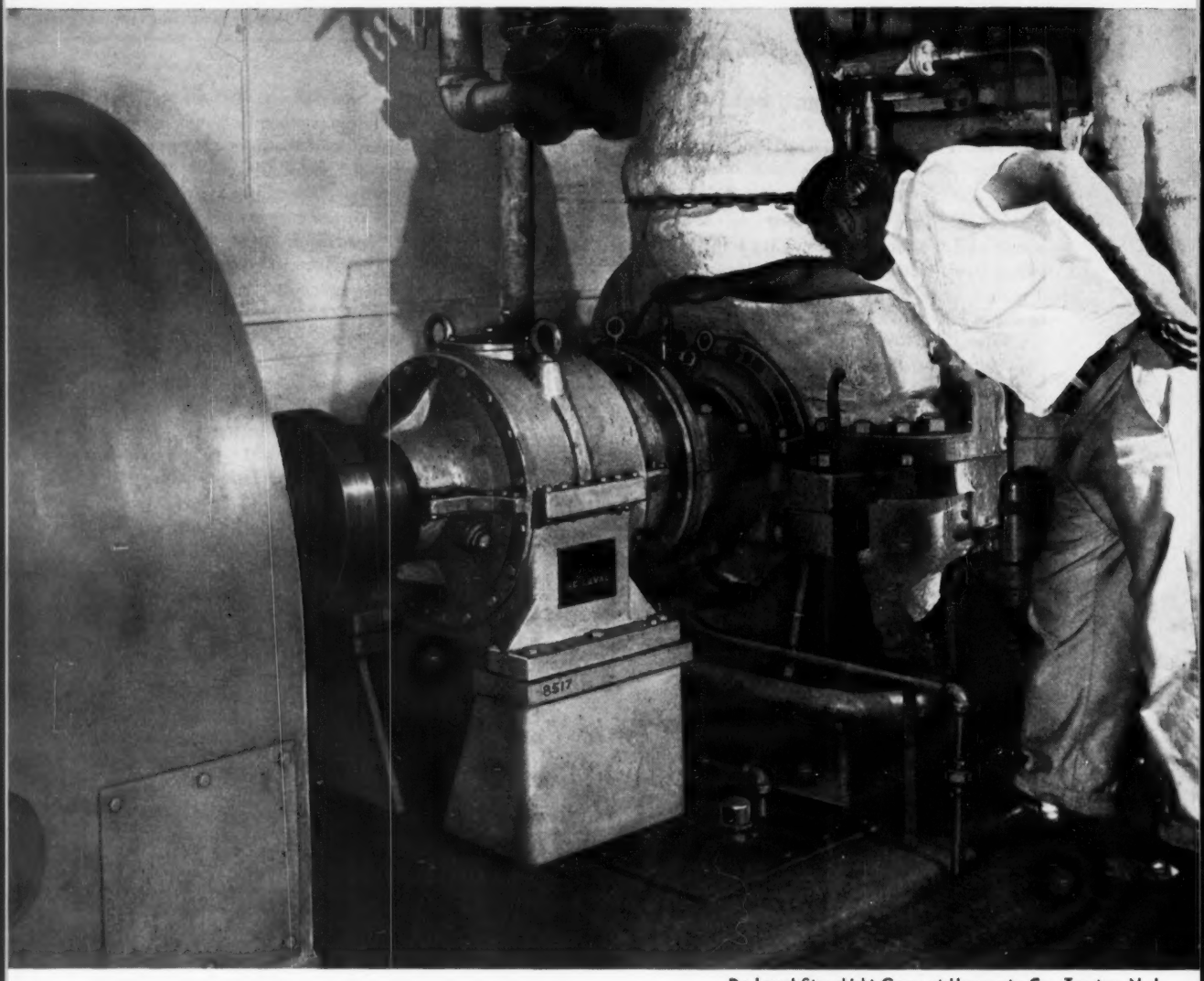
High-school grads cool on engineering

Enrollment of engineering freshmen in U.S. colleges and universities showed a sharp 7.6% decrease over the preceding year. This was the finding of Dr Raymond Walters, president of U of Cincinnati. Considering attrition rate of engineering students, the class of 1962 will be small. A brighter note: Survey also revealed enrollment in teachers' colleges and university education departments was up nearly 19%.

But not so here . . .

Newark College of Engineering reports that 10% of 575 applicants rejected from entrance to this year's freshman class could probably have done successful work if there had been room for them. A "space-dictated quota system" is forcing NCE to reject students who even a few years ago would have been accepted. While many of these students undoubtedly found places elsewhere, F A Grammer, NCE's dean of admissions, states others like them will not be able to do so by 1960. A check of last June's graduates found that 10% of those who graduated would not now be accepted because of the higher entrance standards prevailing.

Creative Engineering by DE LAVAL



De Laval-Stoeckicht Gear at Homasote Co., Trenton, N. J.

2800 Horsepower in a 22" package!

That compact "package" you see in the center of the picture above is a De Laval-Stoeckicht Planetary Gear. Developed by W. G. Stoeckicht in Germany, this gear has been proved in hundreds of European installations. It is capable of transmitting 2800 horsepower from the steam turbine at the right to the generator at the left. It weighs only 900 pounds. A conventional gear for this service would weigh 4000 pounds. And the De Laval-Stoeckicht gear takes up less than half the space of a conventional gear. This is another example of how De Laval *creative engineering* plus precision manufacturing and highest quality control assure lasting customer satisfaction.

DL 440

DE LAVAL *Steam Turbine Company*

815 Nottingham Way, Trenton 2, New Jersey

For more facts circle 298 on Reader Service Card, p 102

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builds these products...

- Centrifugal pumps
- Barrel type feed pumps
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- Centrifugal gas pipeline compressors
- IMO positive displacement pumps
- Worm gears and speed reducers
- Diesel engine turbochargers
- Planetary gears
- Multi-stage steam turbines
- Turbine generators
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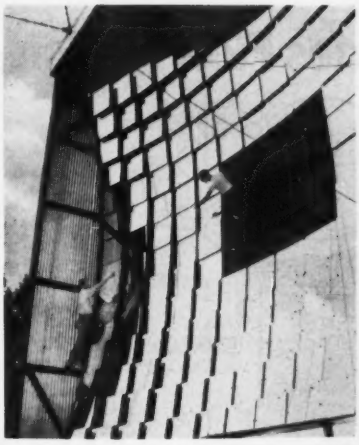
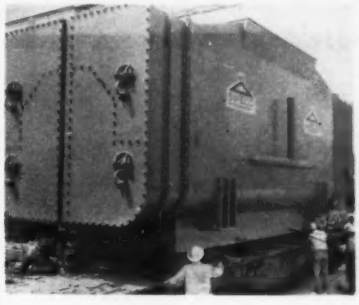
Reports from the field



Another step is taken in race to harness the sun

The Army's giant solar furnace in Natick, Mass. is designed to produce high thermal flux, rather than high temperatures. But a sample exposed to furnace's concentrated energy should reach 5000 F at image position —same thermal radiation received by personnel in the vicinity of nuclear-weapons explosions.

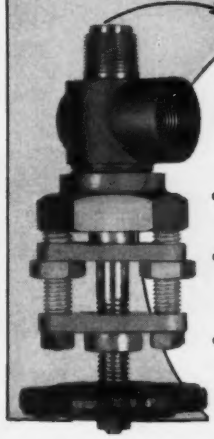
Concave mirror framework, the heart of the furnace, is made of 180 spherical mirrors manufactured by the American Optical Company. Each is 2x2 ft. Final radius is 472 in., produced without grinding and polishing. New furnace should lose little heat through absorption, because its design uses a front-surface mirror.



Mammoth 117-ton condenser will up plant capacity 60%

Record-size, 38,000-sq-ft-surface unit will condense discharge from a 44,000-kw steam turbine-generator assembly to be installed at the City of Burbank's power plant. Custom-engineered condenser was designed by

New!
Jerguson Drain or Sampling Valve



- completely self-draining
- withstands severe conditions
- foolproof operation

¾" size shown

The new Jerguson No. 23 Drain or Sampling Valve is completely self draining, for the valve stem seats on the outside of the valve body. It is ideal for installations where it is desirable to have the valve seat inside the wall of a vessel in order to prevent the typical condition of liquid remaining in the nipple and valve inlet.

This rugged, new Jerguson Valve has outside screw and yoke construction to meet high temperature or corrosive conditions where inside threads cannot be tolerated. The efficient outside thread design eliminates possible freezing and allows the valve stem to work freely at all times. The No. 23 Valve provides foolproof operation because the stem is constructed with a left-hand thread, thus allowing the valve handle to operate in the normal direction of standard valves.

Available in sizes from ¾" to 2" N.P.T. ¾" and 1" sizes are recommended for pressures of 4000 lbs. @ 100° F. and 1000 lbs. @ 750° F.; 1¼, 1½ and 2" sizes are recommended for 600 lbs. @ 100° F. and 250 lbs. @ 750° F. Optional features include construction with additional outlet for such uses as a steaming out connection and with a reamer on the end of the stem to break away encrusted matter which may have collected on the inside vessel wall.

Write for data unit and complete details.

JERGUSON
Gages and Valves for the Observation of Liquids and Levels
JERGUSON GAGE & VALVE COMPANY
100 Adams Street, Burlington, Mass.
Offices in Major Cities
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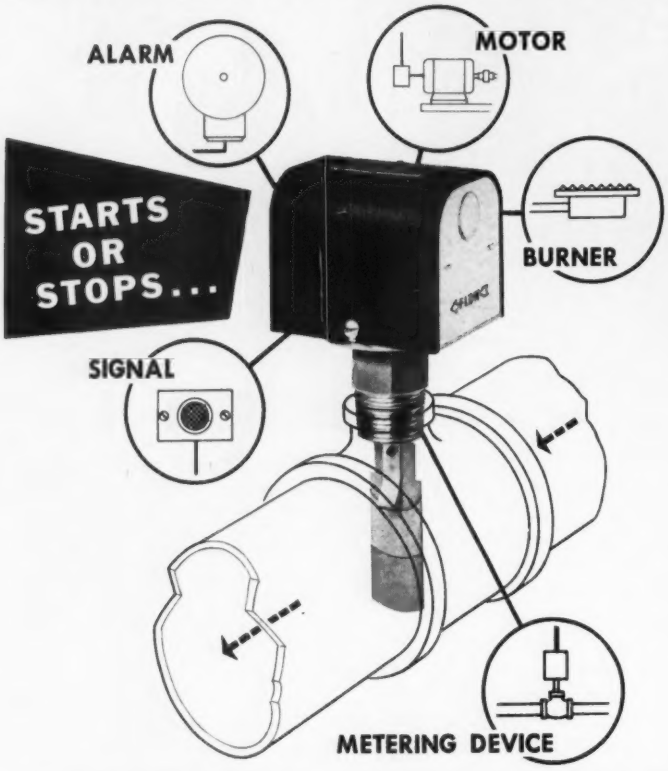
Pétrole Service, Paris, France

Makes or breaks a circuit when flow STARTS . . . or STOPS

McDonnell FS4 Series Flow Switch



The illustration tells the story of the McDonnell FS4 Flow Switch. Installed in a pipe line, it is a moderately priced, highly dependable device that makes or breaks a circuit when flowing liquid moves the paddle—to perform almost endless functions vital to safety and automatic operation. Underwriters' Listed.

New Bulletin FS-1 fully covers all details of construction and service ranges. Also contains typical applications that may suggest important services the FS4 Flow Switch can perform in your plant.

McDONNEL & MILLER, Inc., 3506 N. Spaulding Ave., Chicago 18, Ill.

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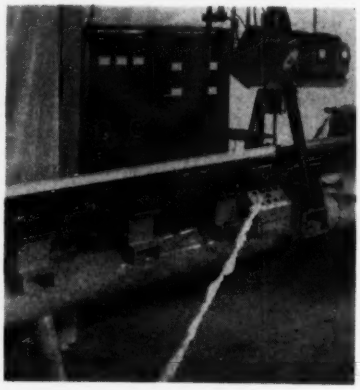
Reports from the field

Begins on page 167

Southwestern Engineering Company to maintain lowest possible absolute pressure consistent with available cooling water.



Continuous ultrasonic welder is 35-ft long, automatic

This machine was first developed in 1955 for a classified contract. Spiral ribs were joined to 15-ft-long tubes by a series of overlapping spot type welds. The process is completely automatic with indexing of tube, locating rib, spacing spot welds and complete cycling done entirely by the machine. All the operator has to do is start the process rolling.

Aeroprojects Incorporated, who built the machine, also has a continuous, ultrasonic, roller type seam welder, in which ultrasonic power is supplied without interruption.

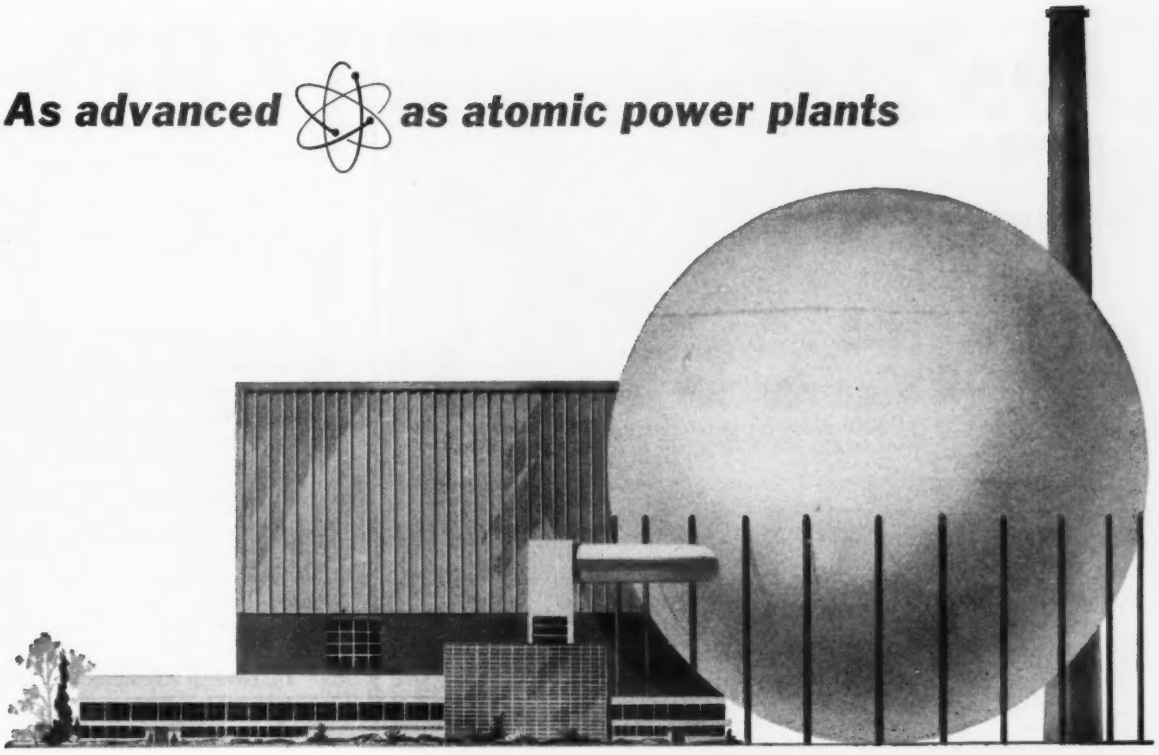
Calendar of Events

Feb 8-14—National Electrical Week. Purpose: To enhance public appreciation of electricity and the contributions of the electrical industry to the nation's progress and economy. Details from National Electrical Week Committee, 290 Madison Ave, New York 17, N. Y.

Mar 8-11—American Society of Mechanical Engineers, Gas Turbine Div, Gas Turbine Conference. Cincinnati, Ohio. Details: ASME, 29 W 39th St, New York 18, N. Y.

continued

As advanced as atomic power plants



INFILCO ION EXCHANGERS

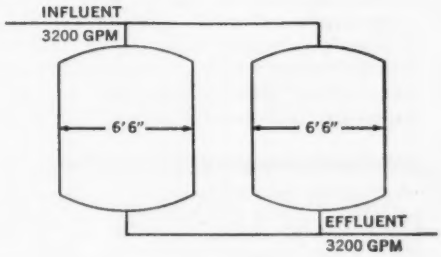
treat boiling water reactor condensate at

50 GPM PER SQUARE FOOT

Two 6'-6" diameter mixed bed demineralizers with a total surface area of 64 sq. ft. are now being installed to handle 3,200 gpm of reactor condensate. These units will produce polished condensate with a conductivity of approximately 0.1 micromho in a fraction of the space and at much lower installation cost than conventional equipment.

The plant design is based upon extensive pilot plant studies using a 24" diameter unit to treat unfiltered condensate at 200 gpm (68 gpm per sq. ft.). The equipment and techniques developed for this plant are also applicable to high pressure conventional and super-critical pressure plants.

Results of pilot plant studies and design features of this ultra-modern installation will be sent free upon request. Write today for Reprint #88.



Infilco Inc., General Offices: Tucson, Arizona, P.O. Box 5033
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"Eminence in equipment design for water, sewage, and waste treatment . . . since 1894."

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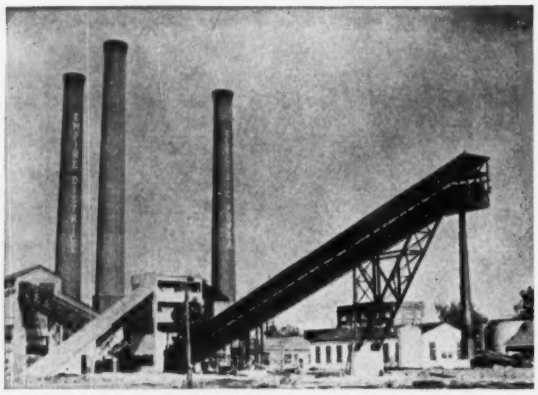
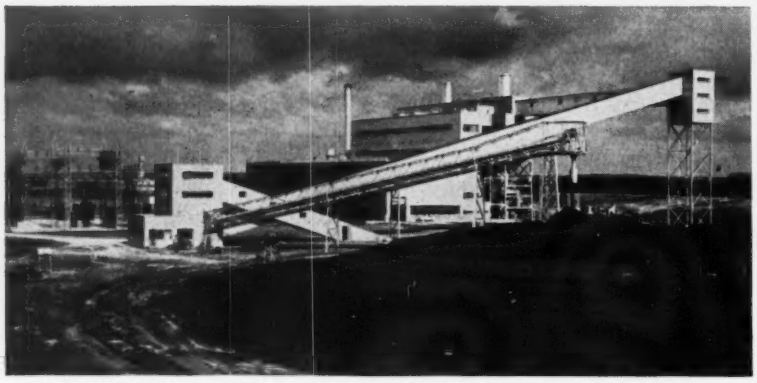


McNally Pittsburg developed this 250 ton per hour system for the EMPIRE DISTRICT POWER & LIGHT CO.



McNally Pittsburg assisted in developing this 300 ton per hour system for the KANSAS POWER & LIGHT CO.

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Engineered for Your Plant

Are you paying "extra fare" luxury rates for that last ride your coal must take from the truck, car, or barge, to your bunkers?

Why pay more? Why risk breakdowns, when you can *save* extra "profits" and be sure of year-round efficiency.

McNALLY PITTSBURG Systems automatically handle more coal per dollar—minimum maintenance costs.

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Reports from the field

Begins on page 167

Mar 16-17—American Society of Mechanical Engineers, Lubrication Div, Spring Conference on Wear of Lubricated Surfaces. Franklin Institute, Philadelphia, Pa. Details from ASME, 29 W 39th St, New York 18, N. Y.

Mar 16-20—National Association of Corrosion Engineers, Annual Conference and Corrosion Show. Chicago, Ill. Details from NACE, 1061 M&M Bldg, Houston 2, Texas.

Mar 16-20—American Society for Metals, Western Metal Exposition and Congress. Pan-Pacific Auditorium and Ambassador Hotel, Los Angeles. Details: Jack Straton, 215 S Clark Drive, Beverly Hills, Calif.

Mar 17-18—Manufacturing Chemists' Association, Air and Water Pollution Conference. Netherlands Hilton Hotel, Cincinnati, Ohio. Details from MCA, 1625 Eye St, NW, Washington 6, D.C.

Mar 31-Apr 2—Illinois Institute of Technology, American Power Conference. Hotel Sherman, Chicago. Details from R A Budenholzer, Illinois Tech, 3300 Federal St, Chicago 16, Ill.

Apr 2-3—American Institute of Mining, Metallurgical and Petroleum Engineers, Conference on Physical Metallurgy of Stress-Corrosion Fracture. Mellon Institute, Pittsburgh, Pa. Details: AIME, 29 W 39th St, New York 18, N. Y.

Apr 5-9—Edison Electric Institute, Annual Convention. New Orleans, La. Details from EEI, 750 3rd Ave, New York City, N. Y.

Apr 5-10—Instrument Society of America, Nuclear Congress. Cleveland, Ohio. Details from Dr S Baron, Burns & Roe, Inc, 160 W Broadway, New York 13, N. Y.

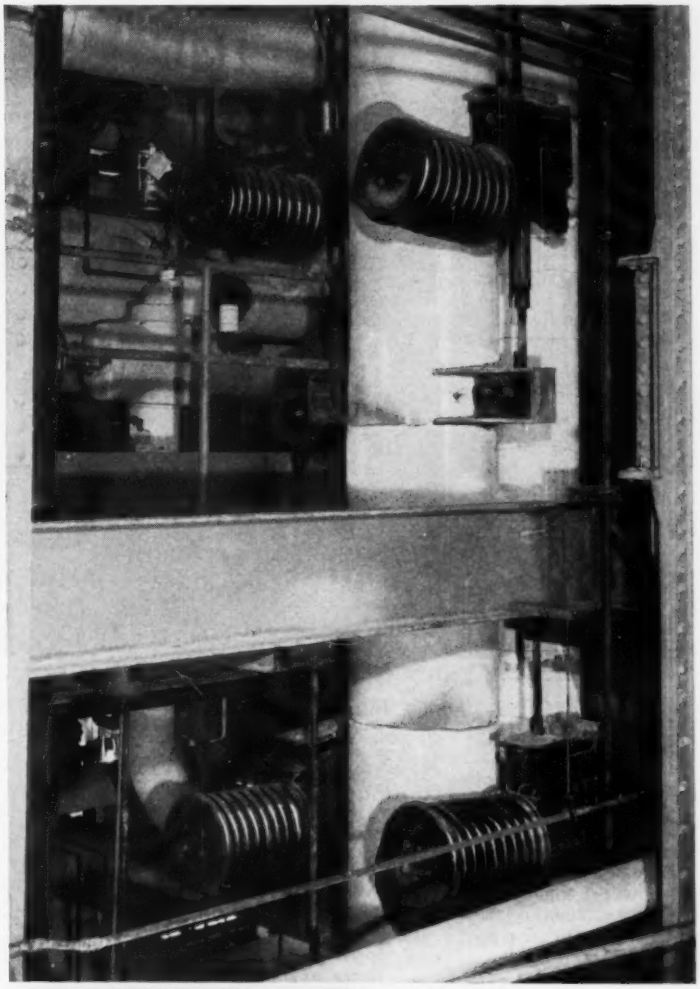
Apr 20-22—Instrument Society of America, Oak Ridge Section, Fifth Annual Southeastern Regional Conference and Exhibit. Gatlinburg, Tenn. Details from J A Russell, 159 Athens Rd, Oak Ridge, Tenn.

continued

For more facts circle 302 on Reader Service Card, p 102

FIRST... in the U.S.A.

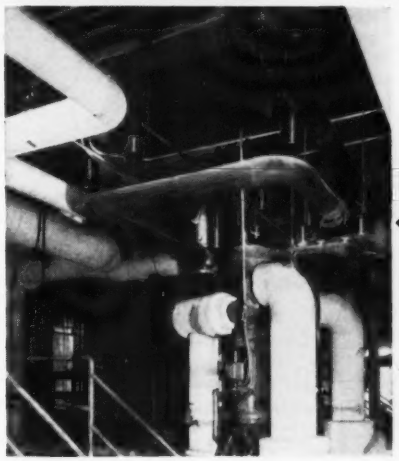
Another in a series of "firsts" has been scored by The Dayton Power and Light Company and Gilbert Associates, Inc., Engineers and Consultants, at the modernized and expanded Frank M. Tait Station . . . a "once-through" Sulzer Monotube Boiler, for subcritical pressures.



In this new-type boiler, water makes a single passage through the tubing, emerging as 2400 psi — 1050/1000 F. steam, which is then delivered to a 130,000 kilowatt turbo-generator.

Because of thermal expansion, the piping carrying this superheated steam must be *flexibly* supported throughout its complete range of movement. Grinnell, America's #1 supplier of pipe hangers and supports, provided the pipe hangers for the *entire,* reconditioned Tait station. Grinnell Hangers were chosen because of their exclusive patented features, superior design and accurate manufacture.

Grinnell invites your problems in pipe support. Remember, you benefit from more than a century of piping specialization when you call on Grinnell.



GRINNELL CONSTANT SUPPORT HANGERS* — Maintain full safety factor in high temperature, high pressure piping. Compact design — extended range of sizes for loads from 31 lbs. to 32,260 lbs., with travels up to 12 inches.

GRINNELL PRE-ENGINEERED SPRING HANGERS* provide a minimum variation in supporting force — a variation of only 10½% of rated capacity per ½ inch deflection for standard spring models. 21 sizes in standard, short and double spring models — capacities 50 lbs. to 28,200 lbs.

**Patented*

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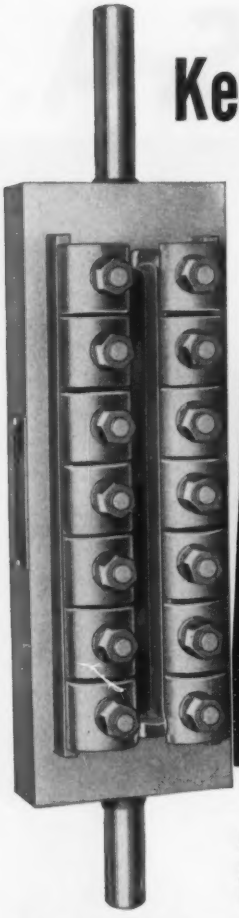
For more facts circle 303 on Reader Service Card, p 102

Keep the "eyes" of your boilers safe

... to protect life and property



Use

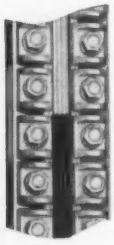
Reliance Water Gage Inserts

for leak-tight shatter-proof service

New Reliance Mica-protected Flat Glass Gage Insert for steam pressures to 1500 psi. Rigid wide body; improved Reliance finger-type clamping principle.

It's false economy to "scrimp" on water gages. These vital basic checks on water levels should be of highest quality, assuring continuous clear reading, and safety for workers and equipment . . . A few hints worth considering:

1. See that you have gage inserts on all boilers and supplementary vessels corresponding with the design pressure.
2. Insist on frequent inspections and maintenance to *prevent* trouble.
3. Keep spare inserts and replacement parts on hand for prompt use when needed. (Many plants use spare inserts when necessary to keep gages in continuous service — make repairs when convenient.)



Reliance PRISMATIC Gage Insert shows sharp black-white contrast between water and steam. Models for pressures to 350 psi.

Reliance, oldest manufacturer *specializing* in boiler safety equipment, makes water gage components for all pressures, any visibility range. Also direct-to-drum assemblies. Extra strength — a generous margin of safety — is built into all Reliance products. When you write, please mention your working pressure.

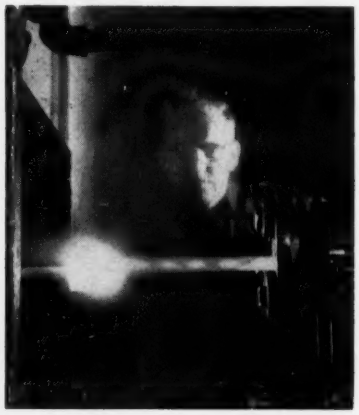
The Reliance Gauge Column Co.
5902 Carnegie Avenue • Cleveland 3, Ohio

Reliance ® BOILER SAFETY DEVICES

1884 75th YEAR 1959

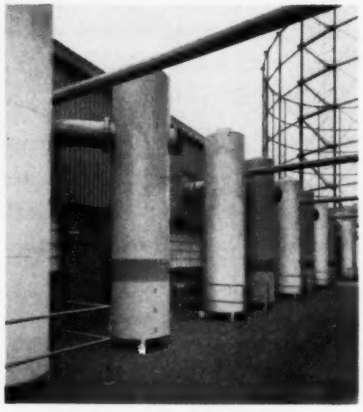
Reports from the field

Begins on page 167



Today's h-t materials must stand up to 5000 F

At one of National Carbon Company's development labs, a technician watches as a new graphite-base material is put through its paces in flame-test chamber. Positioned in a jet of exhaust gases traveling five times the speed of sound—note diamond-shaped supersonic nodes—the conical specimen reaches a white heat of 5000 F in seconds, then holds its dimensions for 80 sec or longer. New knowledge gained may lead to a whole family of h-t materials for military equipment and industry.



The only good neighbor is a quiet neighbor

Minimum noise is the watchword at the Ducommun St Compressor Station of Southern California Gas Co. Air-intake cleaner-silencers and side-inlet exhaust snubbers were installed on each of eight large gas-engine driven compressors. The station has set new

Here's a vertical turbine with

TERRY SOLID WHEEL

and all its advantages

When it comes to judging a turbine's ability to deliver in vertical service, ratings tell only half the story. It's the Terry construction refinements that give you assurance of long-range operational economy: Thrust bearing designed to absorb external pump thrusts ... carbon ring glands specially made for vertical operation ... casings and bearing housings split vertically for easy accessibility.

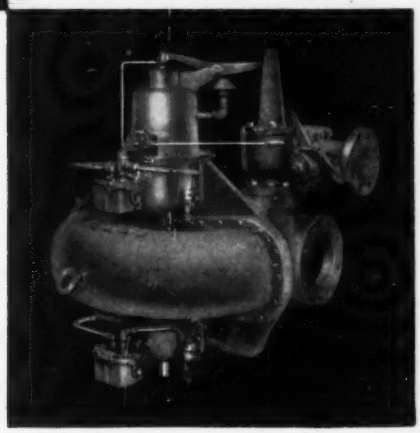
But most important, the Terry vertical turbine has an *almost* indestructible rotor. A single forging of special composition steel, it has no separate parts to loosen or work out. As the only function of the blades is to form a series of pockets, any wear which might occur would not materially affect horsepower or efficiency.

If your application demands a vertical turbine, specify Terry solid wheel. Available in capacities from 5 to 300 horsepower. And remember, the extra durability built into these vertical turbines is typical of every turbine in the complete Terry line.

For further information, send for a copy of bulletin S-137.

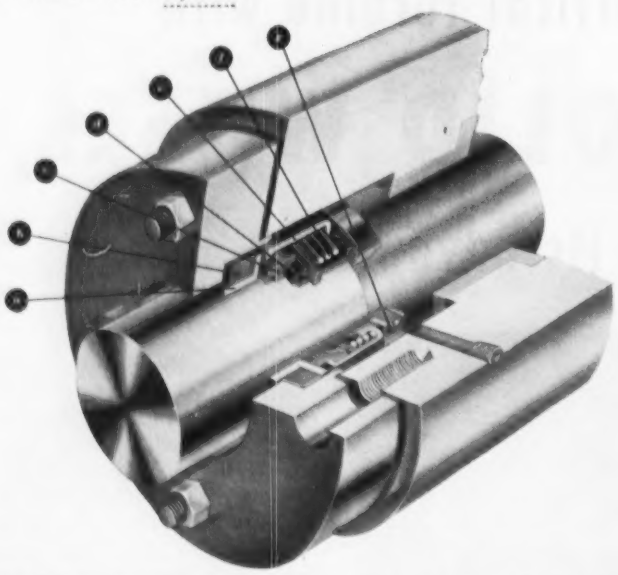
THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TERRY



For more facts circle 305 on Reader Service Card, p 102

ONE OF THE GARLOCK **2,000**



GARLOCK Mechanical Seals —self-contained for easy installation, less downtime

a. ***Stationary Seat*** *of ceramic, Ni Resist, or bronze has precision lapped sealing face for perfect contact with carbon ring.*

b. ***Vibration Ring*** *of Buna-N positions stationary seat in a flexible mounting and acts as static seal.*

c. ***Seal Ring*** *of carbon is also precisely lapped to match sealing face of stationary seat.*

d. ***Roll type Bellows*** *permits free movement of seal ring.*

e. ***Shell,*** *encases entire rotary unit and furnishes mechanical drive for seal ring.*

f. ***Stainless Steel Spring*** *with load precisely calculated to face area of seal.*

g. ***Stop Collar,*** *or shoulder, positions seal to specified operating length.*

Garlock's PK MECHANIPAK* is designed to avoid excessive downtime. Self-contained, it can be installed simply and quickly, and eliminates adjustment during operation. Seal life is equal to many sets of conventional packings. Check these additional advantages:

Leak-proof sealing. Sealing faces of rotating and stationary parts are precision lapped for perfect contact, thus preventing leakage.

Elimination of shaft wear. No parts of the seal move on the shaft or sleeve, thus removing the danger of scoring or wear.

Maximum operating conditions are 212° F temperature, 150 psi pressure, 2000 fpm shaft speed. Available in shaft sizes from ⅜″ to 3″, PK MECHANIPAK Seals are another of the Garlock 2,000 . . . two thousand different styles of packings, gaskets, and seals for every need. Find out more by talking with your local Garlock representative, or write for Catalog AD-150.

*Registered Trade Mark

THE GARLOCK PACKING COMPANY, Palmyra, N.Y.

FOR PROMPT SERVICE, contact one of our 30 sales offices and warehouses throughout the U.S. and Canada.

GARLOCK

Packings, Gaskets, Oil Seals, Mechanical Seals, Molded and Extruded Rubber, Plastic Products

CANADIAN DIVISION: The Garlock Packing Co. of Canada Ltd.
PLASTICS DIVISION: United States Gasket Company

Reports from the field

Begins on page 167

records for quietness, and the maintenance problem of pulsation has been eliminated. Silencers and snubbers are products of Burgess-Manning Co.

Motor will power pumps for largest municipal plant

Six pumps, driven by six 1250-hp synchronous motors, above, will supply as much as ½ billion gpd of cooling water for Memphis Light, Gas & Water Div's new Thos A Allen electric generating station. Largest steam power plant ever authorized at one time by any municipality, plant is rated at 750,000 kw, to be derived from three tandem turbine generators. Each of three 12-story boilers will have seven cyclone furnaces to burn crushed coal or natural gas, generate 2400-psig steam.

Pressure-vessel head formed at a single stroke

Largest, thickest, heaviest pressure vessel closure ever made at a single

The face of a commercial center

Architects and Engineers: Lane, Gamble and Associates; General Contractors: Robert E. McKee, Inc., and J. E. Morgan and Sons; Heating and Plumbing Contractors: Kieffer Plumbing and Heating Co., and Sam P. Wallace and Co.; Mechanical Engineers: Blum and Guerrero, and William K. Hall and Co.

. . . and its heart

THIS IS EXCHANGE PARK IN DALLAS, TEXAS—a 125-million dollar commercial development of five multi-story office buildings, a regional shopping center, a hotel and a complete medical center.

Over 300 tons of USS National Seamless Pipe in sizes from 2⅜" through 24" were used in the heating and cooling system which serves the center from a utility plant. Steam at 250 psi working pressure is generated in the utility plant by five 50,000-pound boilers whose combined steam capacity is 250,000 pounds. This plant also has a refrigeration capacity of 12,000 tons, supplied by a system capable of handling close to 34,000 gallons of condenser water per minute, and is capable of meeting the needs of a city with 36,000 people.

Do you need quality pipe for power, heating and air-conditioning installations? You'll get it when you ask for "NATIONAL PIPE." If you'd like further information or immediate assistance with your pipe problems, write to National Tube Division, United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

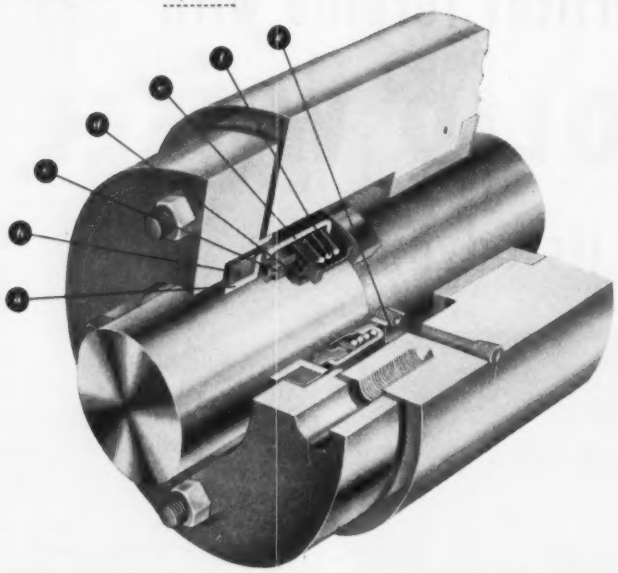
USS and National are registered trademarks

National Tube Division of United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
United States Steel Export Company, New York

"The world's largest and most experienced manufacturer of tubular products"

ONE OF THE GARLOCK **2,000**



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*Registered Trade Mark

THE GARLOCK PACKING COMPANY, Palmyra, N.Y.

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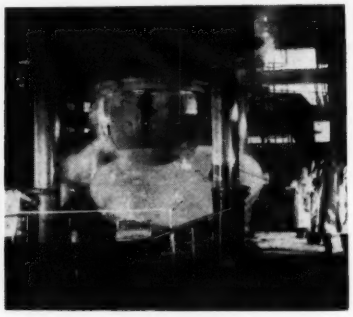

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USS and National are registered trademarks

National Tube Division of United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
United States Steel Export Company, New York

"The world's largest and most experienced manufacturer of tubular products"

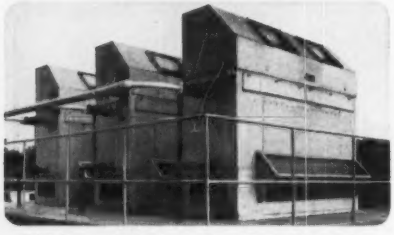
For more facts circle 307 on Reader Service Card, p 102

MODERNIZING?

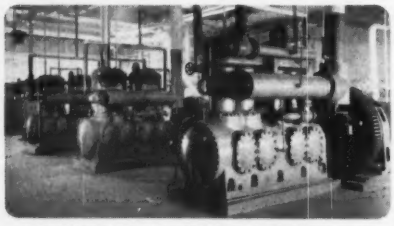
Check TRADE FRICK MARK® Refrigeration

FOR ALL YOUR NEEDS

- CONDENSERS
- PIPE COILS
- SHELL-ICE MAKERS
- VALVES & FITTINGS
- ICE RESERVE UNITS
- AIR HANDLING UNITS
- SHELL & TUBE COOLERS
- "ECLIPSE" COMPRESSORS
- HEAVY-DUTY COMPRESSORS
- QUICK-FREEZING SYSTEMS
- "INSTANT" WATER COOLERS
- MULTI-STAGE COMPRESSOR SYSTEMS
- LOW PRESSURE REFRIGERATION UNITS
- AUTOMATIC CONTROLS & DEFROSTING SYSTEMS
- COMPLETELY ENGINEERED SYSTEMS, DELIVERED AND INSTALLED



Frick Evaporative Condensers Save Up To 95% Of The Water Used.



Frick Heavy-Duty Four Cylinder Compressors Can Be Adapted to Handle Any Type of Refrigerant.

Frick Shell-Ice—Clear Solid Pieces of Curved Ice. Made Automatically, Without Snow or Waste.

It is a proven fact that today's semi- and full-automatic equipment soon saves enough to pay for itself.

Whatever the refrigeration requirements of your plant—quick freezing, ice making, cold storage, humidity control, low temperatures, condensing, air conditioning, or any process cooling . . . Frick engineers will help you modernize your present system or design one to meet your needs.

Frick refrigeration equipment is world renowned for a long trouble-free life of dependable operation. Many Frick compressors have been in operation for over 40 years.

CALL your nearest Frick Branch of Distributor today. Or write direct to . . . . .

DEPENDABLE REFRIGERATION SINCE 1882

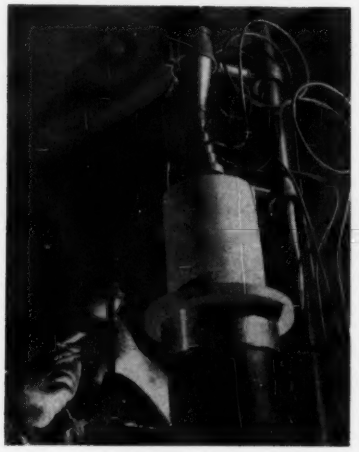
FRICK CO.

WAYNESBORO, PENNA., U. S. A.

Reports from the field

Begins on page 167

stroke by dye-forming is a hemisphere 11 ft across and 5½ ft deep. Well-rehearsed team of six men, protected by heat-resistant clothing, handled operation. Finished head will form lower end of 38x11-ft 225-ton pressure vessel of a nuclear reactor to be installed for Consolidated Edison Co of N.Y. Babcock & Wilcox Co made the head.



Heat changed to electricity by new class of materials

In the future, heat of a burning fuel or other h-t source may be converted directly into electricity. New thermoelectric materials produce electricity simply, silently, without moving parts. Their discovery was announced last September third by Dr Clarence Zener, director of research for Westinghouse Electric Corp.

To be useful for power generation, a thermoelectric material must operate at high temperature *and* be efficient. The thermoelectric effect has been observed in metals, which have satisfactory h-t qualities, but because these are good conductors their efficiency is low. Semiconductors may have good efficiency, but not at high temperatures. The materials in the new class are nonconductors—insulators—of a ceramic type. They operate at very promising efficiencies, at temperatures as high as 2000 and 3000 F.

If successful, thermoelectric power generation will probably be used to supplement conventional methods, or provide power where the conventional methods are impractical.

POWELL

world's largest family of valves

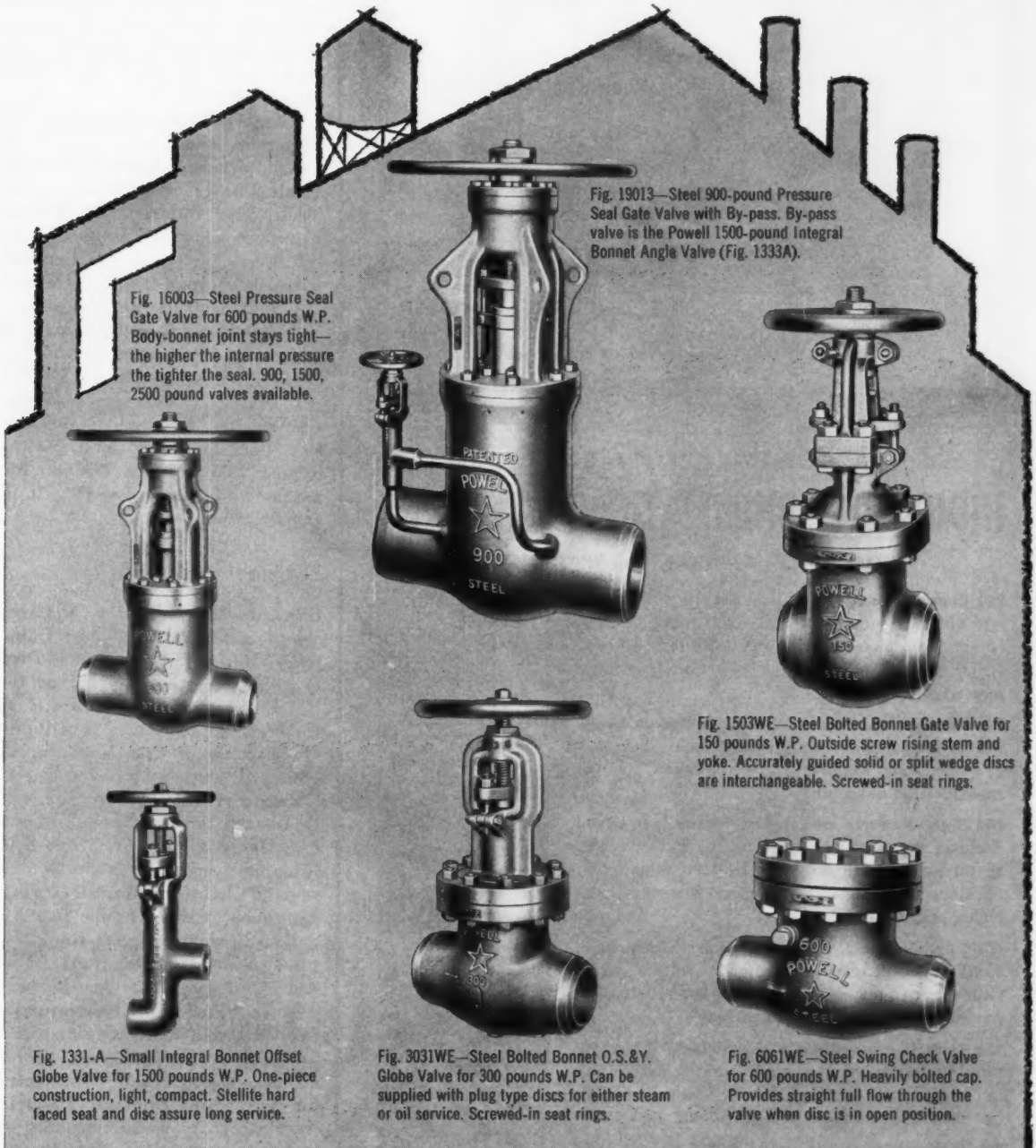


Fig. 19013—Steel 900-pound Pressure Seal Gate Valve with By-pass. By-pass valve is the Powell 1500-pound Integral Bonnet Angle Valve (Fig. 1333A).

Fig. 16003—Steel Pressure Seal Gate Valve for 600 pounds W.P. Body-bonnet joint stays tight—the higher the internal pressure the tighter the seal. 900, 1500, 2500 pound valves available.

Fig. 1503WE—Steel Bolted Bonnet Gate Valve for 150 pounds W.P. Outside screw rising stem and yoke. Accurately guided solid or split wedge discs are interchangeable. Screwed-in seat rings.

Fig. 1331-A—Small Integral Bonnet Offset Globe Valve for 1500 pounds W.P. One-piece construction, light, compact. Stellite hard faced seat and disc assure long service.

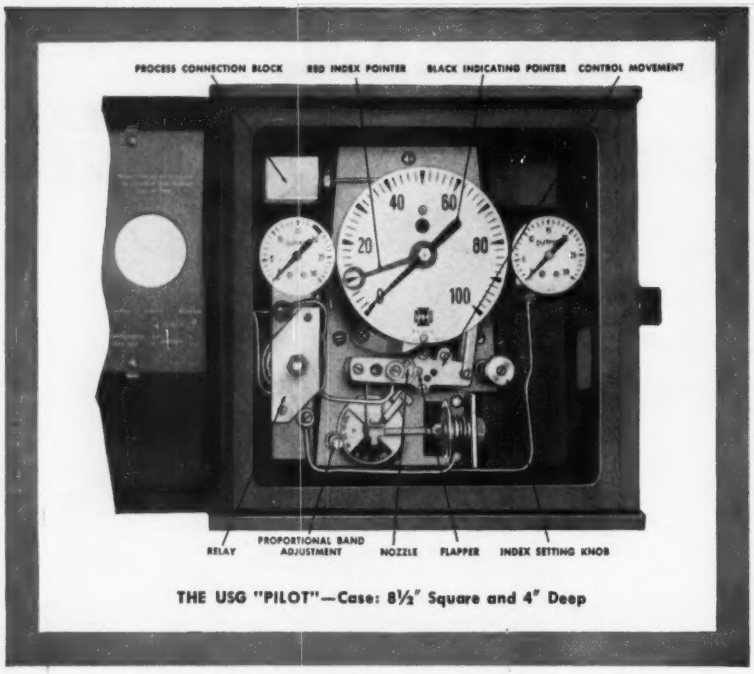
Fig. 3031WE—Steel Bolted Bonnet O.S.&Y. Globe Valve for 300 pounds W.P. Can be supplied with plug type discs for either steam or oil service. Screwed-in seat rings.

Fig. 6061WE—Steel Swing Check Valve for 600 pounds W.P. Heavily bolted cap. Provides straight full flow through the valve when disc is in open position.

For every flow control problem Powell offers more kinds or types, available in the largest variety of metals and alloys to handle every flow control requirement. Powell distributors are located in all principal cities and maintain inventories to fill almost any need. For special engineering problems, write direct to:

THE WM. POWELL COMPANY • *Dependable Valves Since 1846* • **Cincinnati 22, Ohio**

For more facts circle 309 on Reader Service Card, p 102



THE USG "PILOT"—Case: 8½" Square and 4" Deep

A COMPACT, LOW-COST*

INDICATING PNEUMATIC CONTROLLER

for pressure . . . temperature . . . other variables

(1) Control modes to suit your process: Two-position with differential gap (1 to 100%) . . . proportional (1 to 150%), alone or with automatic reset or rate action. Control mode or control action (direct or reverse) easily altered in field.

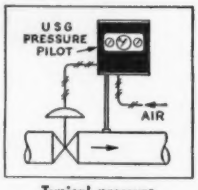
(2) Variable and set point both indicated on large dial: Black pointer indicates reading on 3½-inch dial (6¾-inch scale length). Red circle-tipped pointer spots location of set point.

(3) High accuracy and sensitivity at low cost: Accuracy of 1% of range over middle half of scale. Sensitivity less than 0.1% of scale at 100% proportional band setting . . . compares favorably with higher-priced controllers.

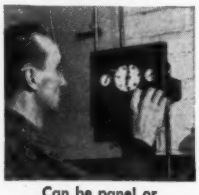
(4) Simplified maintenance and repair: Precalibrated measuring element can be removed for range change. Other basic components, even entire control chassis, can be removed for easy maintenance.

(5) Controls a broad range of variables: Pressures from 30" Hg vacuum to 10,000 psi. Temperatures from —350 F to + 1000 F. Can be adapted to control many other variables, including liquid level.

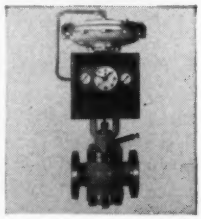
**Sample price: $126.00 for unit with 316 S.S. Bourdon tube, range 0-600 psi, proportional control 1-100%.*



Typical pressure reducing service



Can be panel or surface mounted



Can be valve mounted

Find Your Nearest Distributor in The 'Yellow Pages'

Write for Catalog 510 . . . Gives complete specifications and description of the USG Pilot as well as pneumatic transmitters and receivers for process instrumentation. Send for your copy today, or contact your nearest USG distributor.

UNITED STATES GAUGE
DIVISION OF AMERICAN MACHINE AND METALS, INC., SELLERSVILLE, PA.

USG

Appointment

Corporation changes

Pfaudler Permutit Inc: Mercer Brugler, board chairman; D A Gaudion, president. **The H K Ferguson Company:** R W Olmstead, president. **Stone & Webster, Inc:** Whitney Stone, board chairman; R N Benjamin, president.

Niagara Blower Company: P H Schoepflin, board chairman; M H Olstad, president. **Ansonia Wire & Cable Co:** Frederick Kenner, president. **The Babcock & Wilcox Company,** Atomic Energy Div: Dr L M Currie, vice-president. **General Electric Company:** R W Smith and H A Strickland Jr, vice-presidents.

Chase Brass & Copper Co: W H Preston, vice-president. **Manning, Maxwell & Moore, Inc:** J F Reed and A R Walkley, vice-presidents. **Rockbestos Products Corporation:** A S Basil, manufacturing vice-president. **Wallace & Tiernan Incorporated,** Equipment Div: T T Quigley, vice-president.

Engineer changes

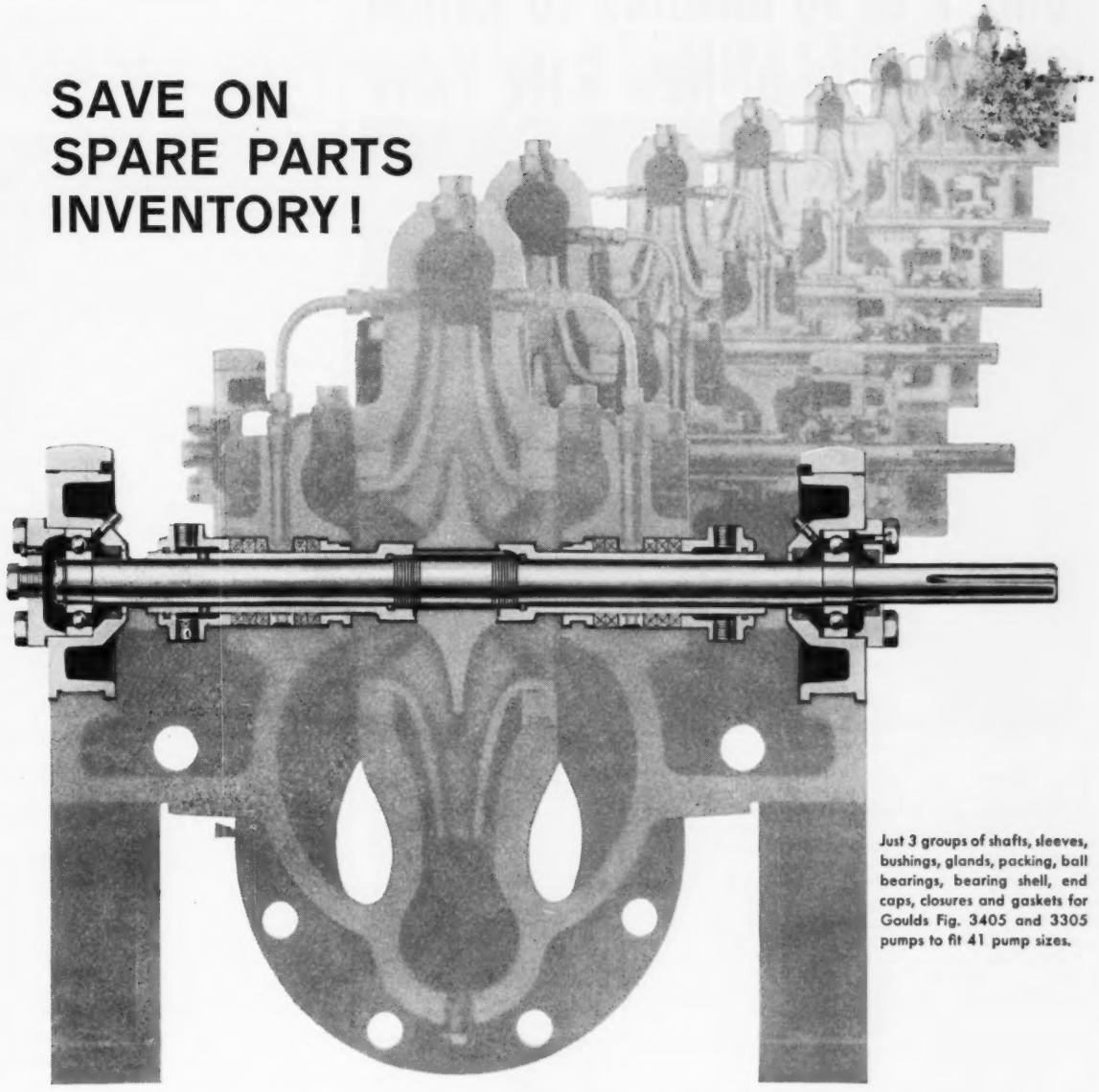
Edward Valves, Inc: C A Siver, chief engineer. **H K Porter Company, Inc,** Delta-Star Electric Div: H Y Mageoch, engineering and research director; A K Alsaker, chief engineer, Chicago Works. **Nordberg Manufacturing Company,** Engine Div: P J Louzecky, chief engineer. **Ebasco Services Incorporated:** F C Tonetti, assistant research director. **Orr & Sembower, Inc:** S N Craig, chief engineer.

Allis-Chalmers Manufacturing Company, Steam Turbine Dept: E P Hansen, chief engineer. **Rockbestos Products Corporation:** J F S Abbott, research and development director. **Beckman Instruments, Inc:** M D Liston, engineering director. **Dravo Corporation:** Robert Hughes, research and development director. **New England Electric System:** E F Walsh, engineer of steam-plant operations.

District sales manager

The Philip Carey Mfg Company: G C Fugett, Chicago. **White Motor Company,** White Diesel Engine Div: H R Ginther, Seattle. **Elliott Com-**

SAVE ON SPARE PARTS INVENTORY!



Just 3 groups of shafts, sleeves, bushings, glands, packing, ball bearings, bearing shell, end caps, closures and gaskets for Goulds Fig. 3405 and 3305 pumps to fit 41 pump sizes.

See how just 3 groups of parts fit 41 pump sizes!

High degree of interchangeability of parts on Goulds Fig. 3405 single-stage and Fig. 3305 two-stage Centrifugal Pumps helps you save four ways:

1. You cut down your spare parts inventory.
2. You can make changes in the field to meet new requirements.
3. Off-the-shelf delivery of standardized parts.
4. You can get lower initial cost, due to standardization of parts during manufacture.

Just three shaft and rotating parts assemblies provide for 41 sizes of these two popular pumps. You cut spare parts inventories *up to 91%*, save the cost of unnecessary overstocking.

Up to 82 pump combinations are possible—considering right- and left-hand rotation—and rotation can be changed in the field due to unique sleeve locking device (patented). Mounting dimensions and motor drive bedplates are standardized to facilitate changing without the additional expense of drilling and tapping.

And . . . you get all of this at low cost! Standard parts make manufacture less costly. Goulds passes on the savings to you.

Find out how this maximum interchangeability can save you money by sending for Bulletins 721.6 and 722.6, or ask your nearest Goulds representative.

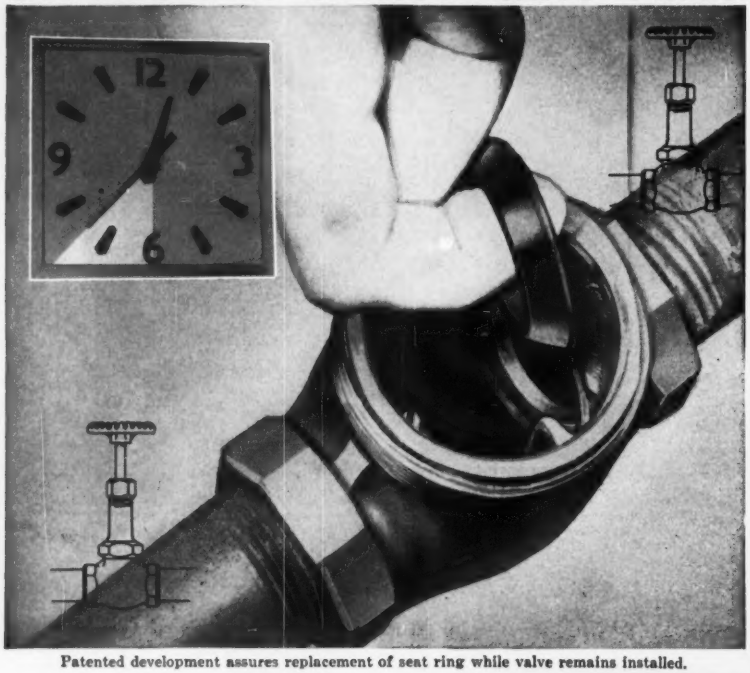
GOULDS PUMPS, INC., Dept. PO-29, Seneca Falls, N. Y.

GOULDS

PUMPS FOR INDUSTRY

For more facts circle 311 on Reader Service Card, p 102

Only 7 to 10 Minutes to Renew Service Life of New Gate Valve



Patented development assures replacement of seat ring while valve remains installed.

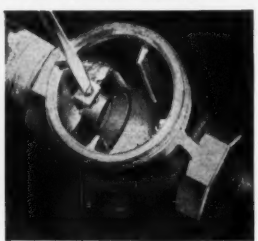
Without removing the valve body from the line, you replace the nickel-alloy seat rings in Fairbanks new patented Renewable Seat Ring Gate Valves. In 7 to 10 minutes, from the time the line is shut down until it is put back into operation, you have given a new service life, a new life of dependable tight closure to your valve.

Just 7 to 10 minutes of your maintenance man's time — only 7 to 10 minutes of "down-time" on your steam, water or process piping lines — and you have the equivalent of a new valve in the line. Think of the savings: where once at least one hour, under the most ideal conditions, was required to replace a gate valve in the line, the job is now accomplished in from 7 to 10 minutes.

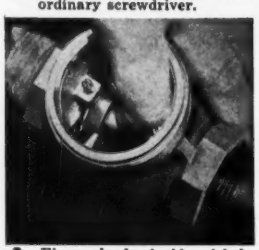
Field tested for over two years, under all conditions from steam to corrosive liquids, the revolutionary new Fairbanks Renewable Seat Ring Bronze Gate Valve has proven completely satisfactory — absolutely dependable.

Made with either rising stem or non-rising stem construction in ½",¾",1", 1¼", 1½" and 2" sizes, the Fairbanks Renewable Seat Ring Bronze Gate Valves are recommended for severe service conditions on 200 lb. steam pressure at 550 degrees F., 400 lb. water, oil or gas pressure — non-shock — lines requiring full flow and subject to frequent operation. Nickel alloy seat rings and wedge make the valves particularly tough and corrosion resistant.

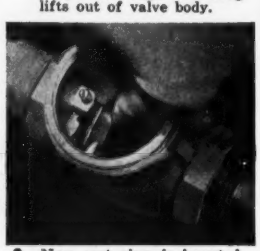
YOURS ON REQUEST: Illustrated, descriptive folder gives complete information on Fairbanks Renewable Seat Ring Gate Valve with details and specifications. Yours without charge. Write today.



1. Union Bonnet removed. Retaining screw loosened with ordinary screwdriver.



2. Finger hooks inside nickel alloy seat ring. Seat ring lifts out of valve body.



3. New seat ring is inserted. Retaining screw tightened. Bonnet replaced.

THE **Fairbanks** COMPANY
393 Lafayette Street, New York 3, N. Y.
Branches:
New York 3 • Boston 10 • Pittsburgh 22 • Rome, Ga.
Valves • Trucks • Casters • Wheels • Dart & "PIC" Unions

Appointments

Begins on page 178

pany: R W Fox, central region; K M Grover, Buffalo; J R Lemmon, eastern region.

Air Reduction Sales Company: F T Wilson Jr, New Orleans. **Allis-Chalmers Manufacturing Company:** J E Watson Jr, New Orleans; W E Scott, Miami. **General Electric Company,** Apparatus Sales Div: J R Casey, manager of user-industries sales for New England.

New names

Pyrometer Company of America, 600 E Lincoln Highway, Penndel, Pa: new organization to manufacture instruments, thermocouples and accessories. **Crouse-Hinds Instrument Company, Inc,** Silver Spring, Md.: special instrumentation recording devices and automation apparatus. **Stone & Webster Engineering N V:** new Stone & Webster Netherlands subsidiary. **Orenda Industrial Inc:** name change for Brush Aboe, Inc. **Vitro Italiana, S p A:** Italian subsidiary of Vitro Corporation of America.

Institute elections, awards

United Engineering Trustees, Inc: Andrew Fletcher, St. Joseph Lead Company, president. **American Gas Association:** W G Hamilton Jr, American Meter Company, director.

Illuminating Engineering Society: A D Hinckley, managing director. **Engineering Foundation,** Welding Research Council: L S Wilcoxson, Babcock and Wilcox Company, executive committee vice-chairman. **National Electrical Manufacturers Association,** Gas Turbine Group: F H Ford, Clark Bros Co, vice-chairman.

J R Killian Jr, Special Assistant to the President for Science and Technology: received the Award of Merit of the American Institute of Consulting Engineers.

Dr F K Schoenfeld, The B F Goodrich Company: Industrial Research Institute Medal for 1959.

Albert Hansen Jr, D D MacCarthy, C R Mason, Myron S Wilson, General Electric Company: elevated to fellow of the American Institute of Electrical Engineers.

100,000 KW power plant addition uses
CHASE ANTIMONIAL ADMIRALTY TUBES

Workers insert first of 8,380 1" O.D. Chase Antimonial Admiralty Tubes used in power plant condenser system. This is part of company's $21,000,000 expansion program to be completed in 1960.

Chase®
BRASS & COPPER CO.
WATERBURY 20, CONNECTICUT
Subsidiary of
Kennecott Copper Corporation

There are nearly 50 miles of Chase Antimonial Admiralty Condenser Tubes in this new 100,000 KW generating unit of a prominent Southwestern power company.

Chase Antimonial Admiralty was chosen because of its favorable cost comparison as well as its enviable "in-service" record. Since Antimonial Admiralty was developed by Chase in 1935, over 125 million pounds of tubes have been put into service in thousands of installations, giving excellent service.

Chase offers unsurpassed technical assistance . . . *first-hand* technical assistance that comes from producing condenser tubes for all types of installations, including raw sea water. For details, contact your Chase representative. Or write Chase, Waterbury 20, Connecticut.

The Nation's Headquarters for Aluminum, Brass, Copper and Stainless Steel

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For more facts circle 313 on Reader Service Card, p 102

SAFE
DEPENDABLE
GENERATOR
OPERATION

Spark Free!
EXPLOSION
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Adaptable
To Any
Industrial
Engine!

Kato's complete line of 50, 60 and 400 cycle revolving field AC Generators is now available in brushless design.

Especially desirable for operation in gaseous environments.

★ GREATLY REDUCED MAINTENANCE!

KATO BRUSHLESS AC GENERATORS

60 CYCLE SIZES
3 Phase: 5 to 400 KW
1 Phase: 5 to 150 KW

SPEEDS
720. 900. 1200. 1800 RPM.

Take your choice throughout the Kato Line — Brushless or standard slip ring types. For all your 400 cycle or power converting needs, investigate Kato's complete line of high frequency alternators and motor generator sets. Complete control systems for all Kato products include Kato magnetic amplifiers, voltage regulators, static exciters and motor starters for synchronous or induction motors.

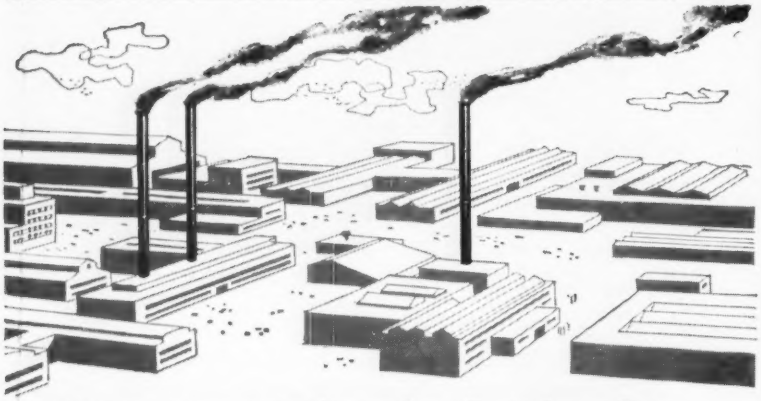
BUILDERS OF FINE ROTATING ELECTRICAL MACHINERY SINCE 1928

NEW BRUSHLESS GENERATOR CATALOG
Write For It Today!

KATO ENGINEERING COMPANY

1479 FIRST AVENUE, MANKATO, MINNESOTA — PHONE 8-2941

For more facts circle 314 on Reader Service Card, p 102



Glass-protected stacks...

Permaglas® smokestacks are glass-protected(inside and out)... are virtually impervious to condensate corrosion

✱ Accelerated life tests prove that *Permaglas* stacks last 3 to 5 times longer than plain steel stacks

✱ *Permaglas* stacks are easy to install—no special equipment needed

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Through research ...a better way

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PERMAGLAS SMOKESTACK SALES
PROCESS EQUIPMENT DIVISION
MILWAUKEE 1, WISCONSIN

A. O. Smith Corporation, Dept. P-29, Milwaukee 1, Wisconsin
Gentlemen: Please send me a copy of the Permaglas Smokestack Bulletin No. SS-202.

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For more facts circle 315 on Reader Service Card, p 102

Bookshelf

Plant Engineering Practice. *By the editors of* Plant Engineering. *8¾ x 11⅝, 704 pp, 800 illust, $18.50. F W Dodge Corp, 119 W 40th St, New York 18, N. Y.*

This handbook covers every major area of plant engineering activity from a practical viewpoint. It does not attempt to discuss theory, but concentrates on offering tested solutions to daily problems.

Detailed studies are organized into 13 sections, covering sites and layout; construction; housekeeping and safety; materials handling; maintenance; paints and protective coatings; mechanical power and piping systems; electric power; lighting; utilities; heating, ventilating and air conditioning; instrumentation and quality control; shopwork.

Betz Handbook of Industrial Water Conditioning, fifth edition. *258 pp, $3.00. Betz Laboratories, Inc, Gillingham and Worth St, Philadelphia 24, Pa.*

Up-to-date text for reference or study is presented in easy-to-understand form. Handbook is detailed, but a specialized knowledge of water chemistry isn't needed to understand basic problems involved and latest developments in water technology.

Introductory chapters are on basic water-treatment processes, such as aeration, coagulation, softening. Then specific water problems, particularly those met in boiler- and cooling-water conditioning, are handled. Applications and limitations of various water-treating equipment and methods are covered.

Engineering Materials Handbook. *Prepared by a staff of specialists; edited by Charles L Mantell, Chairman, Dept of Chemical Engineering, Newark College of Engineering. 1936 pp, 6 x 9, 648 illustrations. $21.50. McGraw-Hill Book Co, 330 W 42nd St, New York 36, N. Y.*

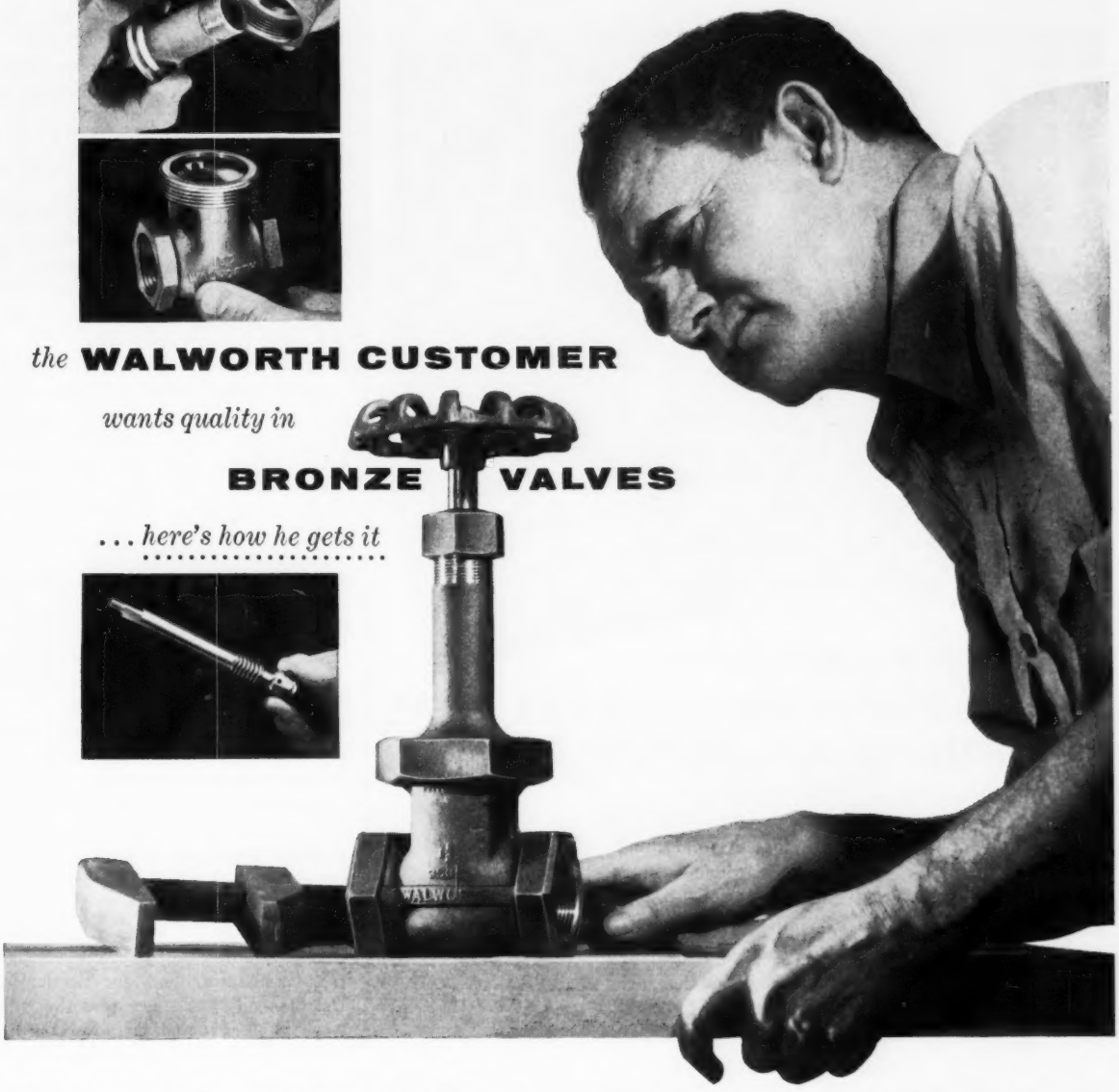
A comprehensive and authoritative reference that considers materials from the viewpoint of engineering structures, machinery, equipment. Handbook covers metals, the organic and inorganic materials, cause and prevention of failure in materials. Emphasis is placed on the fabricated

the **WALWORTH CUSTOMER**

wants quality in

BRONZE VALVES

. . . here's how he gets it



When he needs Bronze Valves, the Walworth Customer grabs a wrench. He wants to *see* the quality. He examines body construction for wall thickness. He looks at stems for length and depth of threads. In Walworth Bronze Valves, the Walworth Customer finds a union body-to-bonnet construction which means easy disassembly. It means no leakage, even after many take-downs and reassemblies. He finds extra-large stems, with extra-long, extra-deep threads. That means protection against wear, and tight, positive shutoffs. With these facts in hand, he buys.

You, too, may be insistent on having your valve facts first-hand, and being certain of long life and minimum maintenance. If those are your buying habits, we'd like you for a Walworth Customer, too. For full information about the complete line of Walworth Bronze Valves and Fittings, ask your Walworth Distributor.

Or write **WALWORTH** *750 Third Avenue, New York 17, N. Y.*

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WALWORTH SUBSIDIARIES: ALLOY STEEL PRODUCTS CO. • CONOFLOW CORPORATION • GROVE VALVE AND REGULATOR CO. M&H VALVE & FITTINGS CO. • SOUTHWEST FABRICATING & WELDING CO., INC. • WALWORTH COMPANY OF CANADA, LTD.

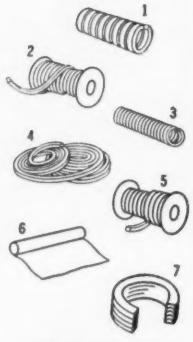
For more facts circle 316 on Reader Service Card, p 102

A mechanical packing problem . . .

HOW AN R/M DISTRIBUTOR STOPPED REJECTS AND SHUTDOWNS ON AN AUTOMATIC MOLDING MACHINE

To avoid rejects and shutdowns, a large manufacturer came to R/M for advice on this automatic rotary molding machine. A packing was needed that would control leakage of hydraulic fluid into the mold with resulting shutdown. R/M Vee-Flex® Packing Rings, one of the Big 7 Packing Types, were recommended and proved to be the answer. Since then the machine has been operating daily for 3 years under a pressure of 1000 psi and at approximately 200°F without need of repacking.

The solution to your own packing problems is as handy as your telephone. The R/M distributor near you has a wide range of experience that is yours for the asking. Remember, too, the R/M Big 7 packing family is carefully engineered for your specific job. Write for your distributor's name and address today.



THE BIG 7 PACKING TYPES

R/M's BIG 7 PACKING TYPES MEET 95% OF ALL PACKING NEEDS

R/M

BIG 7 PACKINGS
RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, PASSAIC, N.J.
MECHANICAL PACKINGS AND GASKET MATERIALS

RAYBESTOS-MANHATTAN, INC., Mechanical Packings • Asbestos Textiles • Industrial Rubber • Engineered Plastics Sintered Metal Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings Brake Blocks • Clutch Facings • Industrial Adhesives • Laundry Pads and Covers • Bowling Balls

Bookshelf

Begins on page 182

forms of materials, their physical and mechanical properties, their adaptations, advantages, limitations, competition with each other, protection against deterioration, increase in stability to withstand use and abuse.

An example of the book's modern scope can be spotted in the first section, which embraces not only steels, all base metals and the precious ones, but also those which are considered uncommon, since a number of the latter are rapidly reaching commercial importance, production.

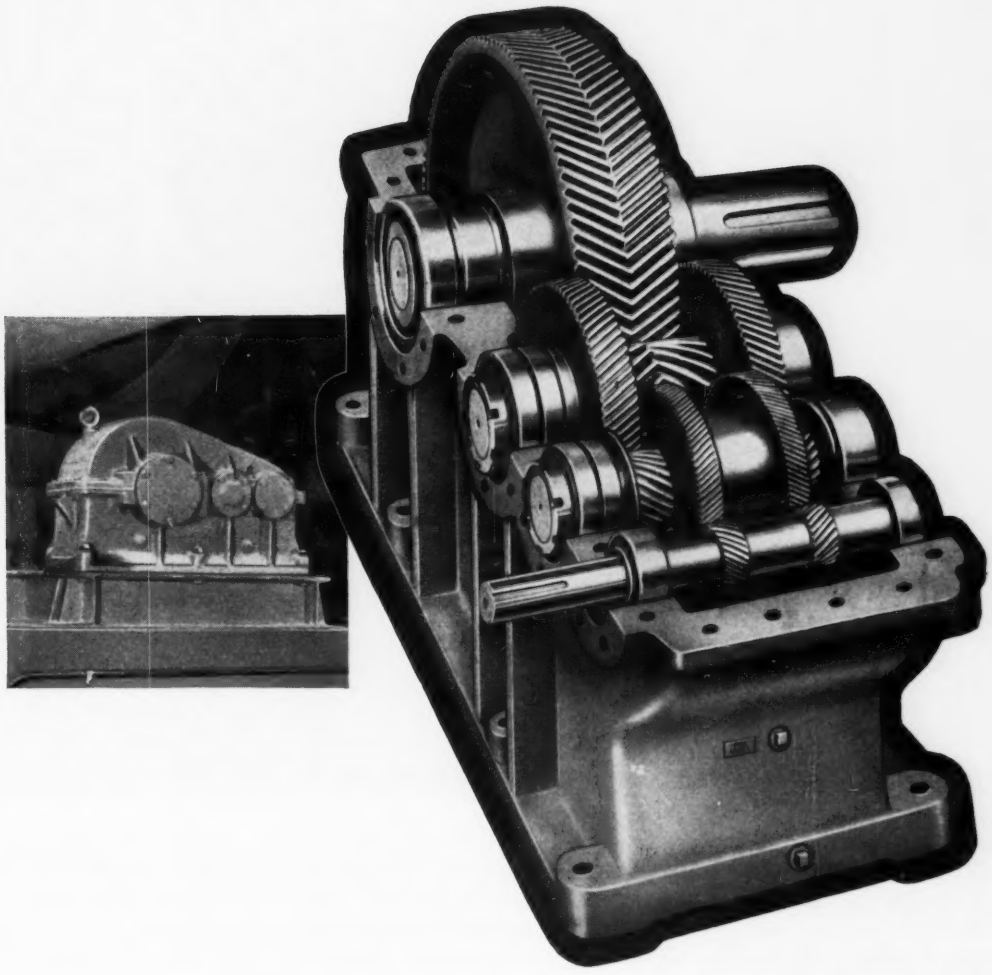
Special sections deal with the materials of construction and apparatus for control and utilization of atomic forces and fission products: power plants and reactors; their safety and insulation against X-rays, gamma rays, beta particles and all the products of fissionable material.

Directory of New England Manufacturers. *Published with the editorial cooperation of the New England Council. 7½ x 11, 788 pp, clothbound, $45.00. George D Hall Company, Boston 9, Mass.*

Book is a comprehensive directory of New England industry, covering alphabetical listing—name, address, corporation officials' names, pertinent info; a geographical section in which manufacturers are listed according to product made; a brand-name section.

Endorsed by the New England Governors' Conference as well as the New England Council for Economic Development, Directory tells the full story of what is made, who makes it, and a multitude of other facts about New England's industries.

"You'd better return this fan—it works backwards."



THE HEAVIER THE LOAD . . . THE MORE YOU NEED

PHILADELPHIA HERRINGBONE REDUCERS

Heavy repeated shock loads . . . high horsepower . . . round-the-clock operation . . . put them together and you have the kind of a job where Philadelphia Herringbone Reducers perform best. They will last longer and save your maintenance dollars because extra strength is built into every part . . . housings, shafting, bearings and gearing.

To be specific:

Housings are specially reinforced at points of greatest stress. Extra heavy bearings take shocks and heavy overhung loads in stride. Result: shaft alignment is accurate . . . and it stays accurate. Gears, pinions and bearings last longer.

To meet the specific needs of each application, gearing is specially designed and symmetrically arranged in the housing. Result: the bearings on each shaft carry equal loads, shaft deflections are minimized, bearings and gearing have higher shock load capacity.

Pound for pound, horsepower for horsepower and dollar for dollar, you can't buy a herringbone reducer that will outlast a Philadelphia. They are designed with *your* heavy duty drive problems in mind . . . so that you will never have a drive problem.

Philadelphia Herringbone Reducers are available in single, double and triple reduction for ratios of 1.75:1 to 292:1. Write today for your copy of Catalog H-55.

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INDUSTRIAL GEARS & SPEED REDUCERS • LIMITORQUE VALVE CONTROLS • FLUID MIXERS • FLEXIBLE COUPLINGS

For more facts circle 318 on Reader Service Card, p 102

George Edwards

pinpoints the seat of a lot of trouble

A little piece entitled "Let's get off our bottoms" appearing in Steve Elonka's *Practical ideas* back in November apparently struck a good many responsive chords across the country.

Steve showed me a batch of letters, all dealing with the same theme—a fault allowed to develop into a real plant snafu mainly because the chief had his backside nailed to his office chair. One letter, from Paul Ziemke in Clinton, Tenn., is typical of some of the almost incredible things that can happen. Further comment isn't necessary.

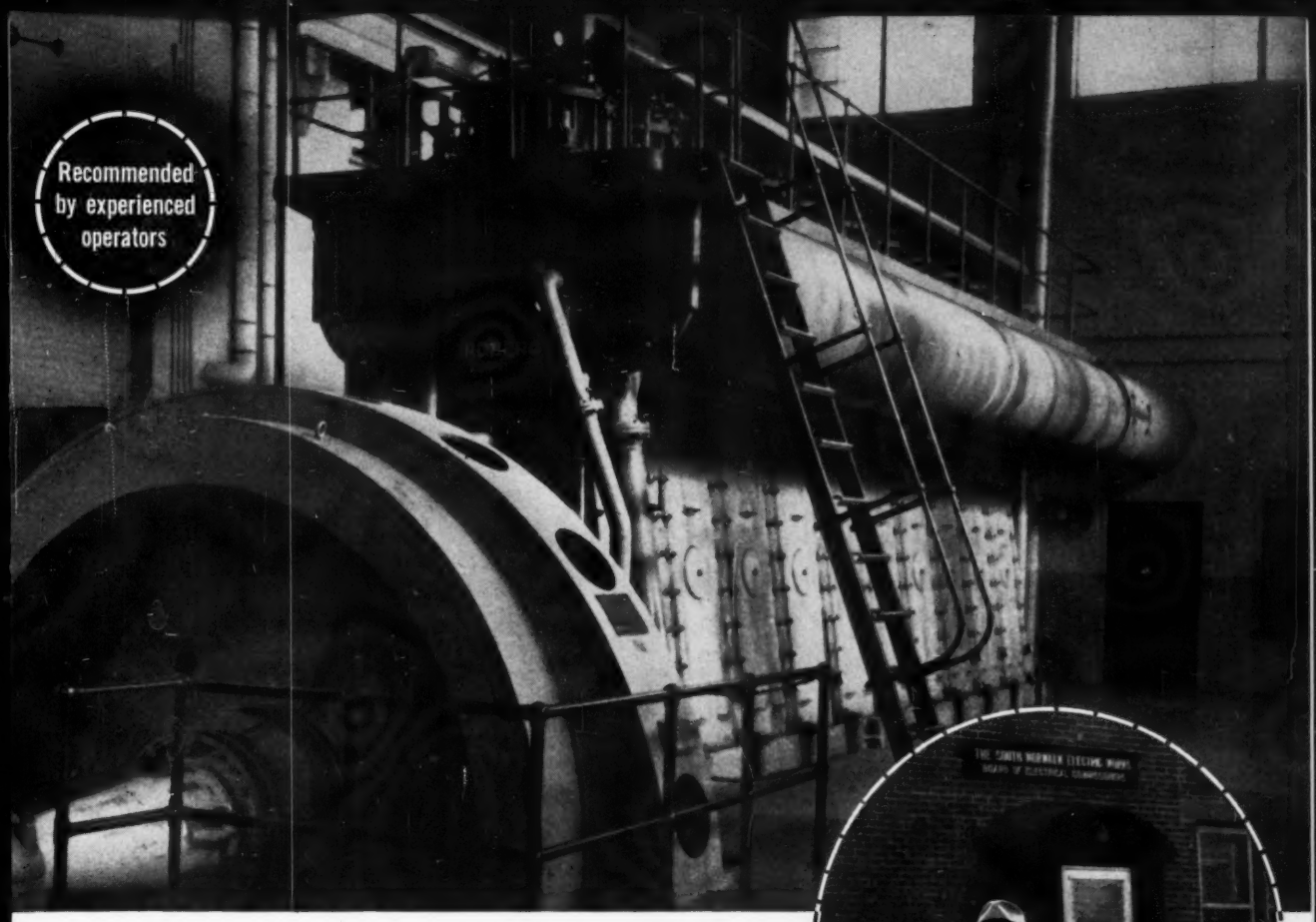
Paul says, "Our armchair strategist finally had to do something about the ever-increasing low voltage on our deep-shaft traction system. His first manifesto decreed complete investigation of all track bonding, to be followed by rebonding as needed. T'was done. Continuing sag of system's terminal voltage resulted in raising generator potential as an emergency stopgap. Next, minute inspection of shaft-installed feeders to locate bad splices in the positive lead, or damage to the bare negative cable. (The latter couldn't have caused the voltage sag since heavy steel sets supported the shaft, and three large pipelines traversed it from end to end.)

Failing to find any serious defect, next step was to check the only remaining portion of the circuit —that buried between head frame and powerhouse. This meant trenching 5-ft deep through 1000 ft of frozen ground. In desperation, the labor foreman wanted to know if there wasn't some less expensive way. To prove the need for a ditch, a Wheatstone bridge was brought into play. Oddly enough, this spotted the fault—right at the concrete pillar supporting a corner of the head frame.

Excavation disclosed a sorry mess of copper arsenate where the power cable paralleled the concrete. Half of the copper had disintegrated from some obscure reaction that had affected only about 2½ ft of cable. With weather so cold, no tell-tale odor was evident, and the true cause came to light only after the opening was enlarged to permit workmen to get at the cable.

The motormen's heated restroom on the headframe's third floor had lacked toilet facilities, and in a moment of brilliancy some nightshift crew had utilized idle time to drop a 2-in. pipe down the headframe's leg to terminate underground next to the concrete pier. Years of usage had saturated the earth, and disintegration of armor, lead and copper conductors through contact with human salts and earth minerals (not to mention electrolysis) became only a matter of time.

If our boss man had gotten out of his chair now and then for a visit with the men on the production front, he'd have learned a lot. Enough, in fact, to discern that voltage throughout the headframe stayed at a normal 250, while everything beyond and underground suffered from electrical anemia. Further, he'd have known that instruments are made to be used, not kept under lock and key.



"confidence in Nordberg . . . we have purchased two additional engines since our first installation"

. . *says Mr. E. J. SPLAN, Gen'l. Supt., South Norwalk Electric Works*

The South Norwalk Electric Works, South Norwalk, Conn., has a long and successful record of supplying reliable electric lighting and power service to its customers. Playing a major role in providing this dependable power are three big Nordberg 2-cycle engines, totaling 10,250 hp.

Mr. E. J. Splan, Gen'l. Supt., speaking for the Board of Electrical Commissioners, has this to say about Nordberg engines *and* Nordberg *service:*

"*Our confidence in Nordberg engines is best expressed by the fact that we have purchased two additional engines since our first installation. We were pleased to find that Nordberg's interest in a customer did not cease with the sale of an engine, and after 17 years of business association that solicitude remains the same. We consider them a friend as well as a supplier of excellent Diesel engines.*"

These, then are additional reasons why experienced operators rely on *Nordberg* to provide the best answer to municipal and industrial power problems.

When you need *long-term, dependable* power, consult Nordberg . . . builders of America's largest line of heavy duty engines, including Diesel, Duafuel® and Spark-Ignition Gas types.

Nordberg Mfg. Co., Milwaukee, Wisconsin.

●

Installation Data . . .

1940—Installed Nordberg 3,000 hp Diesel, rated 2,000 kw.

1942—Installed second Nordberg 3,000 hp, 2,000 kw Diesel.

1951—Installed third Nordberg Diesel . . . a 10-cylinder unit rated 4,250 horsepower, 3,000 kilowatts.

NORDBERG

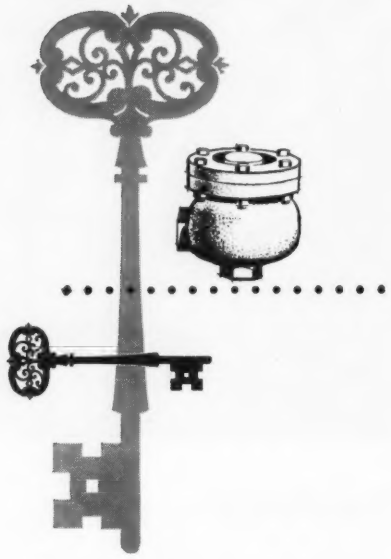
DIESEL • DUAFUEL® AND SPARK-IGNITION GAS ENGINES

© 1957, Nordberg Mfg. Co.

P957

For more facts circle 319 on Reader Service Card, p 102

Who Holds the Key in Turnkey?



Not the consulting engineer.

Not the prime contractor.

Not the subcontractors.

Not even the customer's representative who, assigned to build a plant and stay within the building budget, is too often willing to forfeit the future for a good cost showing today.

The key to this plant's productivity and profits is held solely by the *owners*.

The owners must, of necessity, think in terms of how much this plant will produce, and at what cost. They must, of necessity, think of *total cost*.

Total cost includes the price of original equipment, the expense of installing it, and how much it costs to maintain it over the entire useful life of the plant.

Take steam traps, for example. Lots of traps cost less than Nicholson's. In a box on the jobber's shelf, that is.

But when the plant *owners* have paid the cost of installation, and "dry, clean steam" has been contaminated by everything from weld bead to broken beer bottles and the *owners* have paid the cost of that, and finally when the "bargain" traps have broken down in service—the *owners* call on Nicholson.

Quality Nicholson steam traps, sometimes higher in initial cost but always lower in installed cost, have long enjoyed the reputation of being the *owners'* favorite—the favorite of the people who, in the long run, have to pay the bill. ST-100

NICHOLSON

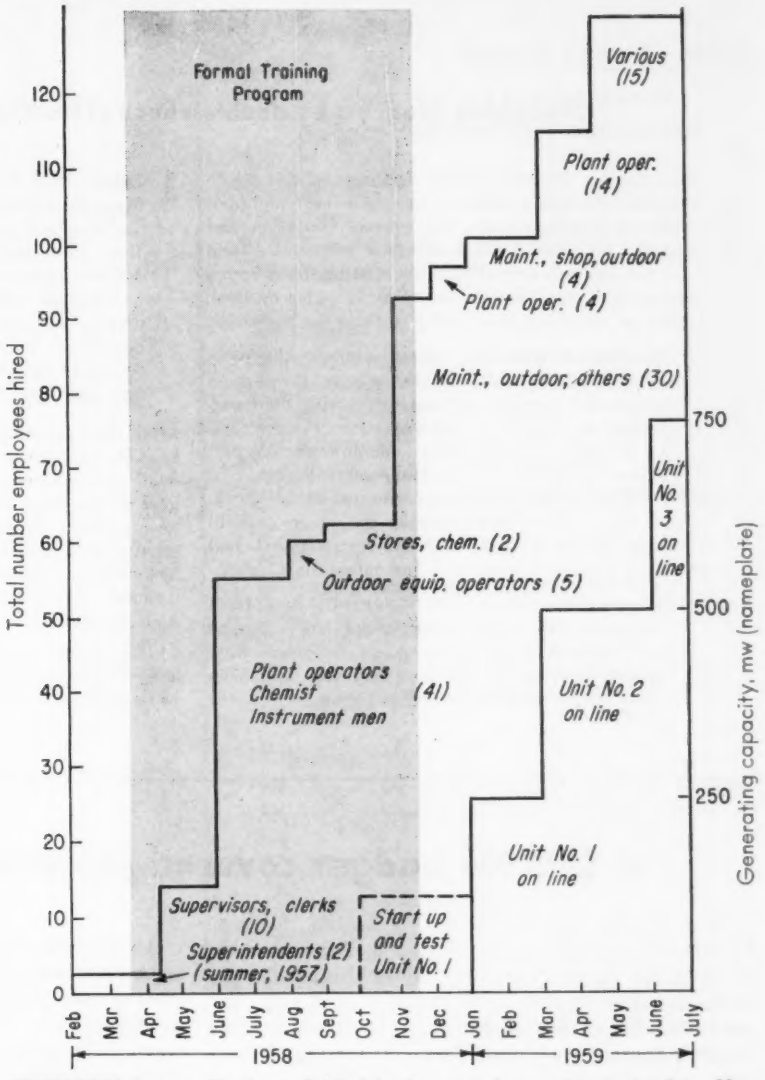
OF WILKES-BARRE

W. H. Nicholson and Co. • 10 Oregon Street • Wilkes-Barre, Pa.

Distributors in all principal cities

Plant maintenance and management section

STEVE ELONKA
Associate Editor in Charge



RECRUITING for unit No. 1 was finished in time to train men for startup date. Men coming in later received on-the-job training, so they were ready for units 2 and 3

Memphis tackles power training

- To become self-sufficient, Tennessee utility had to build its first power plant. Memphis LG & W Division did just that —but it meant a big training program
- Plant's engineering consultants were called in. They recruited, developed courses and guided training
- Trainees watched plant construction, attended classroom sessions, then helped put first unit on line

By K R WILLIAMS
Burns and Roe, Inc

continued

Organizing program by double-check system hit the target date

Coordinating lecture material, lecturers, and dates to present talks meant reams of correspondence and hundreds of telephone calls. To prevent confusion and evaluate progress, a check-off chart was used. Then a target date was set for formally starting the program and most of these details had to be in order by then. Items on the check sheet fell into three main groups:

1 Contact. A letter was sent to station equipment manufacturers explaining the course, its requirements and purpose, and formally asking their participation. Second, a followup letter was sent out. It supplied course details and information pertinent to the individual equipment vendors.

Dates of both letters were entered on the check-off chart. Consultants running the program could then tell at a glance which manufacturers had been contacted, when and how many times.

2 Lesson plans. These were forwarded to equipment suppliers after initial contact. Suppliers confirmed and returned them. Date on which lessons were mailed was logged; the fact that they had been returned was simply checked.

3 Details were checked. A course as extensive as the Memphis training program needs many visual aids —slides and animated models—to be most effective. Checking made sure that aids were ready before classes started.

Program schedules were prepared and confirmed. Finally, names of instructors were listed beside the course name, time allotted for each course in minutes, the time of day for each lecture and dates lectures were to be given.

After the course got under way, continued checking kept the program going smoothly. As each week drew near, weekly schedules were reviewed; monthly reports gave a long-range view of what should occur the following month. The monthly reports listed course name, starting and completion dates, instructor's name and lecture room, trainees enrolled and drop-outs. An attendance sheet was kept, listing important data on each student—names, departments, supervisors.

This paper work was exacting and tedious, but helped keep the training program running smoothly while operators were being prepared for startup.

A $125,000 budget covered pre-program coordination,

In 1955 the Memphis Light, Gas and Water Division surveyed the rapidly increasing power demands of its territory and decided to build Memphis' first municipal generating station; this would end the Division's practice of purchasing all power from TVA. Plans were made to build a plant with capacity for 700,000 customers, plus growth. The first 250,000-kw generator went on line at the new Thomas H Allen station Nov 21, 1958. Two more equal-sized units will be on line by mid-1959.

Switching from the extreme of purchasing all power, to generating all power, meant more than building a $121-million station. It involved a king-sized staffing problem. The Division turned the problem over to their consulting engineers, Burns and Roe, Inc. Instructions: get all men possible from the Division roster, then use other sources. Next, train them. Budget for project was $125,000.

Training problem was complicated by the size of the staff needed and by the mixture of experienced and semi-experienced trainees entering the program. To overcome this complication, consultants designed a program integrating the various courses, activities, and experience levels involved.

Activities of program were planned in three phases: recruiting personnel and developing the individual courses, training supervisors in administrative procedures and techniques, and basic training of operators and supervisors in operation and maintenance of plant and equipment. Courses were scheduled so each group participated in the orientation of the following group.

An instructor experienced in training programs was retained to assist in supervising the operation. Development of specific courses began in September, 1957, ended in March, 1958. Arrangements were made for 28 of the equipment suppliers to provide lecturers, literature and necessary visual aids by the date scheduled for classroom instruction.

Screening of personnel started with the Division's 3200 employees in November, 1957 and continued until the following March. About half the plant staff came from Division ranks; most of the balance was found in the South-central states.

Program was approved by the Division and began April 15, 1958. It ended in the middle of November. When formal courses stopped, training shifted over to an on-the-job basis. All plant personnel hired before the 7-month instruction period was completed, from utility operator to superintendent, participated in the training plan.

During the first three days of indoctrination, members of the station staff were introduced to the City of Memphis. They toured the area, saw films on Memphis and the state of Tennessee, and met many of the city notables. Wives of the supervisors were invited to several social functions to help welcome newcomers to the community.

The orientation course followed, lasting 40 hours. It covered the Division's history, services, and territories, and stressed importance of the city's first municipal generating station. Personnel policies, wages and purchasing procedures were explained. Station facilities were covered

Here's the 3-part course outline

1 Preliminary training program

Induction of supervisors	18 hr
Orientation course	40 hr

2 Supervisory development program

Effective-speaking course	40 hr
Conference-leadership course	40 hr
Basics of supervision course	80 hr
Reception of employees	80 hr

3 Basic training program

Induction of employees	8 hr
Orientation course	40 hr
Project description	40 hr
Coal preparation and handling	40 hr
Boilers and auxiliary equipment	80 hr
Boiler-feedwater system	80 hr
Turbine-generator and auxiliaries	80 hr
Tagging protection, communication	40 hr
Fire-protection-system course	40 hr

One typical course was on boilers and auxiliary equipment

First day
AM General description of boiler components
PM Operation of boiler components

Second day
AM Operation of boiler components, continued
PM Burner and boiler operation

Third day
AM Burner and boiler operation, continued
PM Operation of reheat system and reheating equipment

Fourth day
AM and PM General description of air compressors

Fifth day
AM Compressor operation: control, soot blowers, station air
PM General description of soot-blowing system

Sixth day
AM General description of soot-blowing system, continued
PM Soot-blower operation: components, typical problems

Seventh day
AM Soot-blower operation, continued
PM Ash- and dust-handling system, description and operation

Eighth day
AM and PM Description of boiler control-system components

Ninth day
AM and PM Operation of the boiler control system

Tenth day
AM to 4:00 PM Continuation of ninth day
4:00 to 5:00 PM High-pressure piping systems

Eleventh day
AM Operation of high-pressure steam system from boiler to turbine
12:00 Noon End of course

lectures, on-the-job training

in detail and two days devoted to safety and first aid.

Basics of supervision, the next section, explored the function and responsibility of management. The group then attacked the problem of getting best cooperation from the staff—how to motivate them, give orders, correct mistakes, handle merit reviews. Capital investment of $121-million warranted thorough supervisory training as well as operator instruction to insure smoothest possible plant operation.

Basic training involved almost every worker in the plant, with a minimum of 448 hours of scheduled classroom instruction for each man on individual plant equipment functions. Classwork was supplemented by on-the-spot tours of construction in progress and later by helping put the first unit in operation.

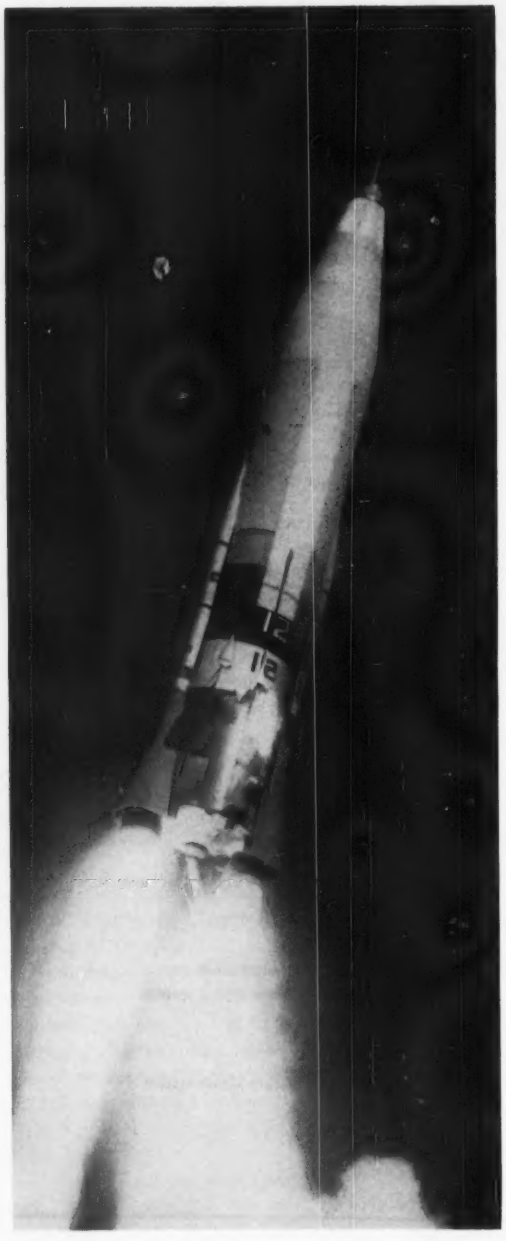
Further courses were given at the equipment suppliers' plants. Since instrument technicians would have responsibility for over a million dollars' worth of instruments, it was worthwhile to send these and other key maintenance men out of the state to study specialized servicing methods. Courses at both station site and manufacturers' plants were most valuable because of the top cooperation of the vendors.

Of the 129 men hired, 12 attended the preliminary training program, 61 took part in the basic program, and about 15 sat in only on those sessions which concerned their specific responsibilities. Oral and written exams were given at the end of each basic course and results were turned over to the Division for employee evaluation.

Added feature of the on-the-job training program was the preparation of each operator to take over the job immediately above his own. For example, turbine operators can step in as boiler operators, and they in turn are qualified to act as assistant central control operators. When a man is unavailable, the entire crew escalates one job level. Vacancy at the lowest level is filled from the utility operator pool. When the absentee returns, everyone who shifted returns to his normal station.

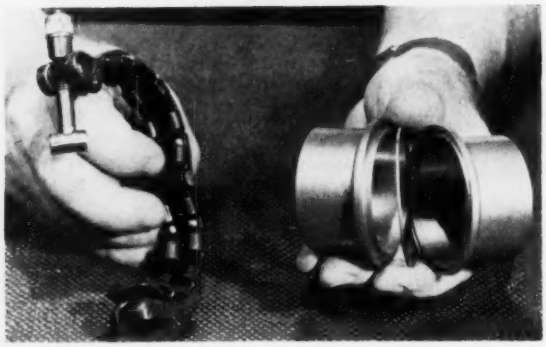
OPERATORS' NOTEBOOK **126**

Now, this missile coupling



ATLAS BALLISTIC MISSILE takes off on 6325-mile flight, powered by rocket engines. Because of sudden temperature and pressure changes, all piping connections take severe beating, and must "breathe" to keep tight. Special coupling shown here was designed to lick these problems, is now available for industrial use. Unique feature is bimetal parts that go into action automatically, compensating for sudden pressure, temperature changes, thereby doing thorough sealing job

Here's how it works



O-RING of hollow stainless steel in V-grooves of mating flanges does the sealing while bimetal coupling holds parts together

Newest thing in pipe couplings is this TCC (temperature compensating coupling) that keeps our intercontinental missiles airborne. Designed for nuclear and missile work, it does its job so well that it now bows in as an all-around pipe connector for industrial plants.

This coupling compensates for temperature because the hotter it gets, the harder it grips the pipe flange and, therefore, seals tighter. Since pipes, tubes and ducts are the arteries of industrial plants, the quick disconnect feature is also important.

Design is simple, light weight and competitive in price with the conventional bolted flange. You can connect and disconnect it in a few minutes because there are only one to four nuts to tighten, depending on size. At present, it handles 8000 psi in ¾-in. diameter pipe sizes, down to 70 psi in 20-in. diameters. Temperatures sealed are from –320 to 1750 F. It also seals vacuum down to 0.8 microns, and is highly corrosion resistant.

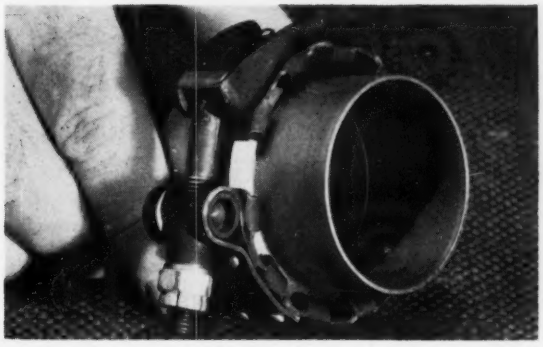
Temperature compensating feature is unusual. Retaining fingers on inside circumference of the Inconel "X" band have semicircular stainless-steel inserts inside them. These nickel-containing type-316 stainless-steel inserts

And here's how to install it

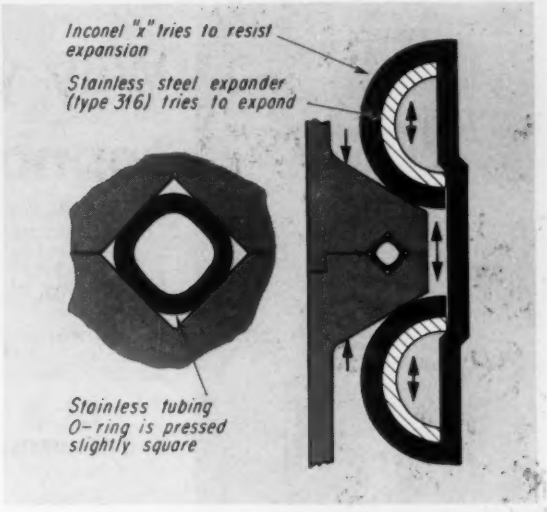
1 Weld flange fittings to piping ends. Each flange face has V-shaped groove for receiving hollow stainless-steel O-ring

is ready to seal your h-t, h-p joints

By STEVE ELONKA, Associate Editor



COUPLED JOINT is compact, needs only one T-bolt in this size to keep flanges tight. Unit compensates for temperature changes


Inconel "x" tries to resist expansion
Stainless steel expander (type 316) tries to expand
Stainless tubing O-ring is pressed slightly square

DETAILS show how O-ring stops leakage throughout joint and also how bimetal coupling tightens flanges as temperature goes up

have a higher coefficient of expansion than the Inconel "X" alloy on the outside. So the higher the flange temperature becomes, the more firmly the expanding stainless-steel inserts press the retaining fingers against the beveled surface of the flange, clamping them together.

At low temperatures, indentations in the Inconel "X" band hold the fingers in place and assure a tight seal—even in subzero conditions.

Method used to connect and disconnect the coupling is simple. In smaller sizes, a single Inconel "X" T-bolt fastens and unfastens it. Four bolts are used in largest size. This makes the coupling handy where periodic disassembly for cleaning or inspection is needed. Coupling has been tried for other than missile work with very good results. Now it's ready for industry.

O-ring (tubing) is stainless type-321 and is placed inside the two V-shaped grooves of the joint that form a right angle, sketch. Because O-ring is slightly larger in diameter than each side of groove, ring is slightly compressed, making an extremely tight joint. Ring and coupling both "breathe" with expansion and contraction of coupling from temperature changes, keeping joint sealed at all times. This is one of unit's unique features.

Parts consist of (1) coupling—comes in one to four segments, depending on diameter (2) flanges with beveled edges and (3) hollow stainless-steel O-ring.

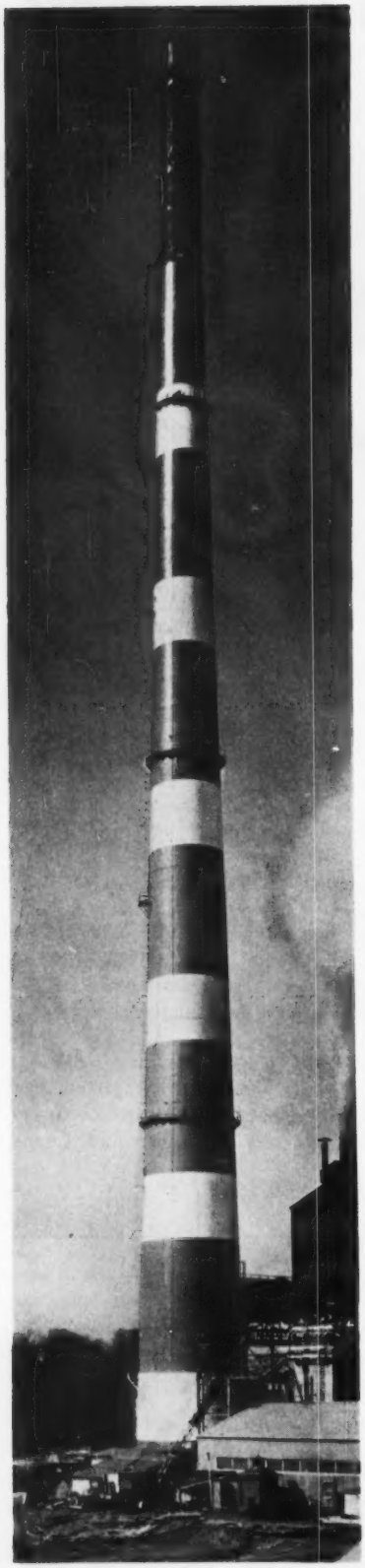
Corrosion resistance of coupling and great strength come from an embossed age-hardened Inconel "X" sectional shell or band that makes up the body of the coupling. This nickel-chromium superalloy has a tensile strength of about 175,000 psi. It also has the needed low rate of expansion that keeps the coupling body from loosening at high temperatures.

Coupling, flanges and stainless-steel O-rings come in sizes ranging from ¾ to 24-in. diameter, giving you variety needed for a large number of applications.—*Courtesy, The D S D Manufacturing Co, Hamden 14, Conn.*

2 Next, insert the O-ring into the flange grooves and bring the flanges together

3 Slip the two-piece clamp into place and take up on the bolts with your fingers

4 Torque the bolts to 60 lb. Seal is now ready for 800 psi at high temperature



HIGH CHIMNEY poses tough repair problems when corrosion, weather attack lining

Why your chimney needs topnotch maintenance

Inspecting, repairing these skyscrapers takes experience. So be sure you give this job to a specialist

By C F SAUEREISEN, President, Sauereisen Cements Company

Modern power plant chimneys present a particularly difficult problem for engineers. Some of them already tower more than 500 feet, and qualified engineers freely predict future chimneys will reach the 1000-ft mark. These huge masses of concrete brick and steel are truly miracles in engineering and design, representing capital investments of hundreds of thousands of dollars.

Yet their construction and repair is so highly specialized a field there are probably less than 100 experts in the United States with the know-how and experience to build them right —engineered to withstand the rigors of acids, fumes, weathering, etc. Design and initial construction are specialized jobs, and inspection or repair require the same professional touch to protect the initial investment.

What has created this highly individualized engineering group? To answer this question we must take a look at construction requirements and techniques for modern chimney builders, and the operating conditions that necessitated special handling.

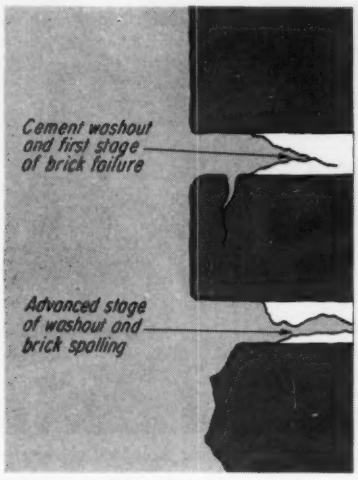
Consider some of the chimney engineer's problems. Slender as they are, chimneys must resist earthquakes. Their exteriors may be exposed to freezing cold while their interiors are subjected to high temperatures or corrosive atmospheres. A knowledge of acid-resisting materials, internal temperature and atmospheric conditions is essential. In addition to general engineering skill, an understanding of ceramics, chemistry and power plant cost balancing is required.

Chimneys stretch higher to help disperse dangerous fumes and flyash. Years ago, the area surrounding many plants was bare of trees and plants. Gases from chimneys settled quickly on the land and blighted it.

Nothing could be done to remedy this situation until engineers were able to raise these stacks. With improved construction methods and scientifically-tested laboratory-controlled materials available, chimneys went high enough to take advantage of prevailing horizontal air currents. These currents disperse fumes and ash over such a wide area that destructive properties of the latter are no longer a problem.

Greater height does not afford a complete solution to stack problems. Chimneys must be protected from attack within by corrosive gases and condensates as well as moisture condensed due to changing atmospheric conditions. These problems lead to development of special cements that resist the constant attack of acids, alkalies, high temperatures and the

Modern fuels and firing methods increase acid attack of chimney lining materials



CEMENT WASHOUT causes joint failure and acid infiltration into main structure

LINING FAILURE shows up in spalled brickwork, joint deterioration, exposing main structure to attack. Use of acid-resistant brick and cement could minimize corrosion

most adverse weather conditions.

Ordinary building cements cannot withstand acids and high temperatures, and most high-temperature refractory cements do not resist water or even high humidity. But the new acidproof refractory cements resist water, solvents, oil, 2000 F and all acids except hydrofluoric.

Exterior of a tall chimney may be constructed of concrete, steel or brick, but the inner linings where the wear and tear is severe due to normally high acid content of flue gas usually is acidproof brick joined with special corrosionproof cements. Many modern chimney linings, such as the one in photo, left, are self-supporting. They're actually chimneys within chimneys, and effectively resist temperatures in excess of 1000 F.

Acid corrosion in chimneys of coal-fired units was a minor problem until the advent of the automatic stoker, pulverized coal and cyclone furnace firing. Adoption of these went hand-in-hand with reduced exit gas temperatures and increased use of lower-grade coals. Increased sulfur and vanadium content often characterizes lower-grade coal supplies. When combined with lower gas temperatures, acids formed create accelerated corrosion. As oil firing became popular the highly corrosive ash and fumes added to the general problem. Lowered gas temperatures meant decreased draft available to induce flow. Designers combated this with fans and venturi caps on chimneys to give an added skyward boost. Both helped create positive pressure in chimneys, increasing infiltration and acid attack of lining and main chimney.

Accelerated lining corrosion and infiltration emphasized the need for careful periodic inspection by experienced engineers. Hairline cracks running through the entire lining thickness are more dangerous than spalled brick, and a lot harder to spot. Big danger with infiltration stems from corrosion of inner face of main chimney structure where adequate inspection is nearly impossible.

Spalled brickwork does not always require repair or replacement. Actual danger here lies in sufficient loss of brick to affect structural strength or, again, formation of through passages to main chimney structure. If lining failure advances beyond the point of maintenance, chimney specialists can replace sections or an entire lining.

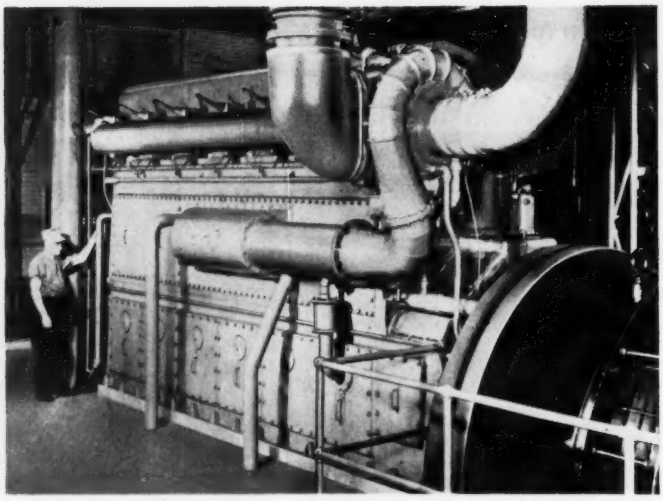
Corrosion and washout usually occur in the upper one-half to one-third of chimneys, depending on entering gas temperature and flue-gas moisture content. Spalling of power plant chimneys normally shows up in the top courses only since temperature cycling required for spalling does not occur in other areas.

Brick is slightly porous, so flue gas penetrates lining. This small amount of infiltration usually is ignored. However, some plants firing oil consider the problem important enough to warrant special coatings of acidproof gunnite etc. One utility plans brick-lined chimneys with lining backed by acidproof block and vapor seal coating.

Inspection normally starts at chimney cap, where greatest damage is anticipated, and proceeds down the lining. A careful check beyond the area of obvious attack often reveals extensive joint weakening. Acid attack of mortar results in softening and breakdown of bond. Although appearing sound, softened areas are unable to prevent further infiltration and camouflage continued attack. Probing apparently sound areas is the only way to uncover extensive attack of this kind.

Through cracks or dislodged bricks should be repaired when discovered. Removal of loose mortar and brick, and thorough cleanout of ash and other deposits precedes actual patching. Materials used should be the best obtainable for the particular service. Since labor costs are such major portions of chimney repair bills, scrimping on materials is foolhardy.

To save maintenance $$$, you can now...



ENGINE IS RUNNING with no load while it is being desludged chemically

Desludge engines without dismantling

By B H BAILEY JR, Magnus Chemical Co, Inc, Garwood N.J.

Chemical desludging removes sludge and engine varnish from internal-combustion engines without dismantling. But first, let's see what sludge is, what causes it, and why and when it should be removed. Then we'll determine how to remove it and with what compound.

What is sludge?

It's a byproduct of the cracking and oxidation of lubricating oil caused by high temperatures and the presence of certain catalysts. Sludge exists in three easily recognized forms: (1) *Soft sludge*—a soft, gummy, black residue in internal-combustion engine crankcases and valve chambers. (2) *Varnish* or *lacquer*—a tough, hard, black, paint-like, continuous film on connecting rods, piston skirts and valve stems. (3) *"coffee-ground" sludge*—a hard, black granular, abrasive deposit usually found on piston rings.

What causes sludge?

Sludge is caused by oil breakdown. Although it can be controlled to some extent, it rarely can be eliminated. Causes of oil breakdown are many (POWER, Dec 1951, p 100). Briefly, main causes of sludge are: (1) Cracking of petroleum oil under high temperatures in piston-ring zone, forming carbonaceous and tarry products. (2) Oxidation of oil to form organic acids. These attack bearing metals, causing pitting and eventual failure. Acids then react with oil to form sludge. (3) Contamination of lube oil with byproducts of combustion, namely, *ash and soot*, which help to build up ring deposits; *unburned "heavy ends,"* which form resinous gummy deposits when cracked or oxidized at high temperatures; *water*, which combines with hydrogen sulfide and sulfur dioxide to form powerful inorganic acids. (4) Contamination of lube oil with minute amounts of metallic oxides. These act as catalysts in accelerating the oxidation and cracking processes. (5) Contamination of lube oil with abrasive dust and dirt drawn through the air-intake system, which accelerates metallic oxide pickup.

Why should sludge be removed?

Sludge should be removed from internal-combustion engines to: (1) Shorten teardown time and subsequent cleaning time when engine is overhauled. (2) Restore a sluggish engine to normal operating efficiency by removing sludge deposits from areas of close tolerances, such as valve stems, piston pins, bearings, etc. (3) Lengthen number of operating hours between general overhauls by removing abrasive sludge deposits. (4) Prevent oil starvation of bearings by removing varnish which restricts flow in oil lines and oil passages. (5) Prevent early contamination when old oil is discarded and new oil is added. (6) Correct poor heat-transfer conditions, such as exist when an oil cooler becomes coated with sludge. (7) Minimize acid attack on bearings by removing acidic deposits.

When should sludge be removed?

When conditions exist as outlined under, "Why should sludge be removed?" These conditions can often be minimized and, in some cases, can be eliminated completely by desludging on a regular maintenance schedule. Degree to which conditions can be eliminated varies with type of engine, type of service, kind of fuel used, etc.

To meet the need for an economical desludging method, chemicals have been developed that can remove sludge without need for dismantling the engine.

How do you desludge an i-c engine chemically?

Chemical desludging is fairly simple. First, drain lube oil from crankcase, remove filters and recap filter compartment. Then remove, clean and reinstall the strainer. Fill crankcase to normal oil level with the desludging compound and start engine, allowing it to idle under no load for 5 to 10 minutes. Gradually advance speed until engine is operating at medium idle. Keep engine running under no-load conditions until visual inspection of valve chamber and crankcase shows that sludge deposits are removed (after one to three hours). Next, clean oil strainer if oil pressure drops. When you finish desludging, shut down engine and drain desludging compound *immediately*. Refill crankcase *immediately* with flushing oil having these characteristics:

Gravity	30.5 average,
Color	2.0
Flash point	415 F
Fire point	465 F
Viscosity	200 ssu @ 100 F, to 95 ssu @ 130 F
Composition	Straight mineral oil

Then start engine and run it at medium idle for 20 to 30 minutes. Finally, stop engine and drain flushing oil *immediately*.

Total desludging time, including flushing, takes from 3 to 6 hours depending on sludge condition and number of times desludging compound has been used previously.

What precautions should be taken?

When desludging, follow these six precautions: (1) Painted crankcases often need special desludging techniques to avoid stripping paint. (2) Watch oil pressure to detect plugging of oil strainer. (3) Watch oil temperature gage to help estimate time needed for desludging. (4) Settle or centrifuge desludging compound before reuse to insure removal of suspended foreign matter. (5) Entire operation of desludging, draining, flushing and draining should be done as fast as possible. Idea is to keep engine "wet" at all times, and to prevent localized deposition of fines.

What is this desludging compound?

A clear, single-phase, dark-colored, slightly alkaline liquid compound specifically formulated for desludging diesel engines without dismantling. It consists of: (1) *Solvents*—chosen for their chemical action on engine varnish and sludge. (2) *Lubricants*—chosen for their effectiveness when combined with solvents. (3) *Thickeners*—to give the proper viscosity. (4) *Reserve alkalinity*—to neutralize the sludge's acid condition.

What does the desludging compound do?

It lubricates and cleans. When circulated through an engine in place of lube oil by running the engine under no-load conditions, soft sludge and engine varnish is removed wherever lubricating oil normally flows. Too, "coffee ground" sludge, often not soluble in any chemical solvent, is removed when held in place by engine varnish. This is extremely important.

Engine is cleaned completely—valves and rings no longer stick and oil temperatures return to normal since the oil cooler is again efficient. Acids attacking bearing metals are neutralized and flushed away. When an engine is to be dismantled after desludging, disassembly is faster and parts no longer require extensive cleaning prior to inspection for defects. Many areas of engine are cleaned thoroughly that cannot be cleaned too well by any other method. These include oil lines and oil passages which if plugged cause oil starvation of bearings and overheating.

What won't this compound do?

It won't: (1) Replace metal—if engine varnish and "coffee ground" sludge deposits are extensive and have been in place long enough to result in metal-wear of cylinder liners, ring glands and bearings, removal of this sludge results in lower compression readings and lower oil pressure. In such cases, desludging points up need for extensive general repairs that are long overdue anyway. (2) Unplug oil lines and oil passages if deposits are heavy enough to prevent flow of desludging compound. (3) Remove sludge deposits completely in areas of low solution flow, such as valve chamber, unless an auxiliary distribution line is installed to augment normal flow. (4) Remove deposits where lubricating oil normally does not flow, such as deposits on piston heads, around top compression ring, in air box and in firing chamber.

Does a service plan go with this compound?

To insure good results and to avoid damage to the engine because of faulty desludging techniques, desludging should only be performed for the first time with expert technical supervision. For this reason the maker has instituted a service plan. The customer uses his own personnel under the supervision of the desludging technician. It is his job to see that the desludging is done properly, and that the customer's personnel are trained in desludging techniques so they can desludge without supervision. For this service the customer pays a flat rate per diem as well as traveling expenses to and from the job. This plan gets you off to a good start.

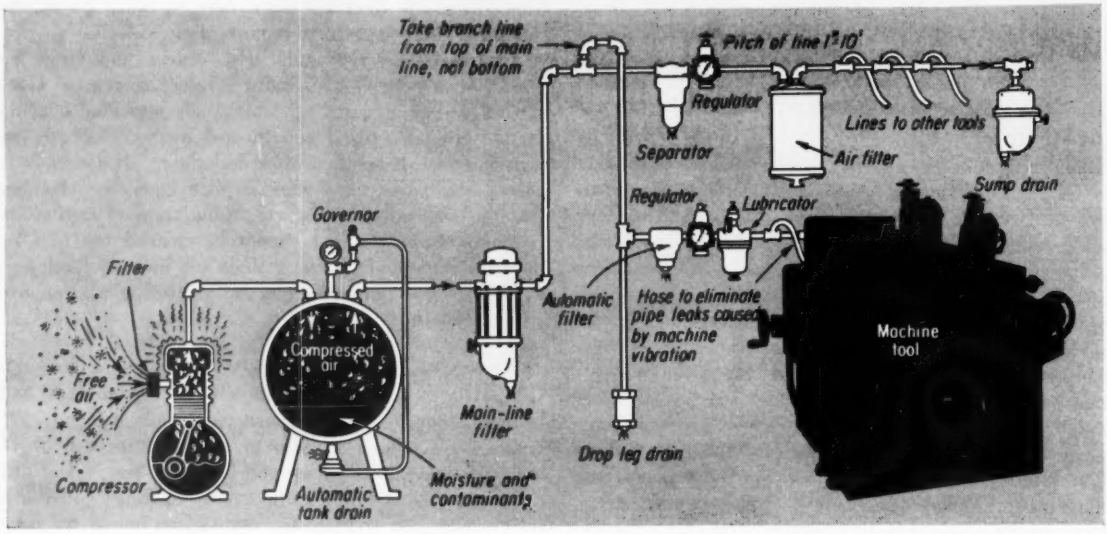
How successful is this desludging method?

In past three years about 60 railroad diesel engines have been desludged successfully. Most of these engines were desludged with a standard compound, but special conditions have also called for other compounds.

Extensive desludging has been done by one railroad. All of their engines were desludged, both during regular maintenance and before general overhauls. Desludging has kept engines in better operating condition during the useful service life between overhauls. It has also cut the costs of disassembly and cleaning for inspection.

Extensive desludging has also been done by another freight line. Their master mechanic states that chemical desludging saves 50% of time normally spent in disassembling and cleaning their engines.

Desludging is being done regularly on large stationary engines, with result that engines now run longer between overhauls and operate at peak efficiency.



COMPRESSED-AIR SYSTEM must be designed to remove moisture, dirt, other contaminants at various points in the lines. Oil is first removed from air supply, later replaced where needed for lubrication. Multiple drains remove condensate from branch lines

Do you know how to get clean, dry compressed air?

By D W BENNER, Wilkerson Corporation

Air systems require as much thought in maintenance and operation as other major power services. This check list for your system can help you deliver better air service

Compressed air ranks with steam and electricity as a major power service, but it's not always treated as carefully. Contamination of air service is just as dangerous and wasteful as in steam or hydraulic systems, producing corrosion, erosion and product contamination. However, just as other service systems can be protected, so can pneumatic ones. Power-service men must give as much attention to filtering, controlling and lubricating pneumatic circuits as they give to other services. Exactly how you operate and maintain your own air system remains a special case, but here are some general pointers on pneumatic systems that will help you get and keep clean air in your plant.

Clean compressed air for plant use begins at the air compressor. Start at the service intake and inspect the entire system. Ask yourself the following questions: Does the compressor suck in heated air from a nearby furnace? Is it bringing in corrosive fumes from a nearby plating operation, or extra moisture from a nearby steam operation? Does it suck in dirt from a nearby cleaning or machine operation? Has the compressor got an efficient filter and is it cleaned regularly?

There are about 865 million dirt particles in a cubic foot of atmospheric air. These things are seldom considered, yet they all cause untold troubles in plant compressed-air lines.

Next, look at your compressor tank. Contaminants are sucked in as if by a big vacuum cleaner. About 9½ cubic feet of atmospheric dirty air is squeezed down to make one cubic foot of compressed air, and the theoretical temperature is raised to as much as 485 F (at 100 psi in a single-stage compressor). Added to this cubic foot of compressed dirt, fumes, oxygen, nitrogen and argon at this high temperature, is moisture. On a day of 60% relative humidity and 70 F room temperature, each cubic foot of atmospheric air will contain about 5 grains of moisture. Squeezing 9½ of these atmospheric cubic feet into one cubic foot of compressed air, we now have about three-

tenths of a pound of moisture mixed with this dirt (oil bypassed from the compressor crankcase, etc).

An 80-gallon air tank, compressed at 100 psi, has about 100 cubic feet of free air stored in that tank, containing about *4 gallons of water.* This can amount to a horrible mess when mixed with dirt and fumes at high temperature. If permitted to get to machine tools, it can cause considerable damage. Start getting rid of this "goo" right at the tank itself, after you've done everything possible to prevent compounding it at the compressor intake. Put an automatic tank drain on the tank to insure that each time this stuff accumulates, the tank will be purged. If the tank is not drained several times a day, it may start filling; air-storage capacity is forfeited and the compressor runs longer and more often, consuming unnecessary power and causing undue wear. Tank drains easily pay for themselves under these conditions.

Not all moisture and stuff is removed at this point. Some of it stays in suspension, moving on to the main lines. Aftercoolers are not the cure-all for compressed-air system trouble of this kind. Experience has shown they usually are *some* help, but expensive additions to a system. They do not remove micronic particles, fumes or compressor oils, and permit these to circulate to machinery in their worst form (dry).

Another solution is a single-unit 2-stage separator-filter, equipped with an automatic drain. It's installed in the main line as far from the compressor as possible and just before the first branch line of the system. This takes out moisture condensed by natural cooling while traveling from the compressor to filter, and the cooling caused by air expansion when moving into the filter unit.

In stage one, the moisture and large contaminants are trapped and automatically removed as they accumulate. Then the relatively clean dry air moves into the second stage of the unit where the filter elment strains out small micron-sized particles, and oil fumes.

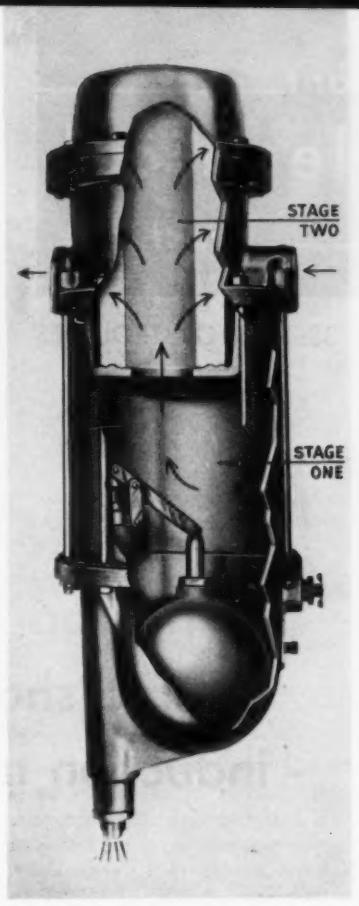
As further cooling can occur beyond that point, equip each place where air is taken from the system with an inexpensive automatic separator to remove any additional condensation, pipe dope and scale before using the air. Many men, for instance, are injured by dirt coming through an air blowgun, hitting a machine part and bouncing back.

These branch lines should be tapped into the top of the main line and fitted with a drop leg and drop-leg drain wherever a vertical run occurs in the piping. Horizontal runs are usually pitched one inch in ten feet, ending in an automatic sump drain after the last branch line.

Air-pressure regulators are important on pneumatic circuits. The tamperproof adjustment type prevents unauthorized personnel from changing settings. Air-pressure regulators control the speed of air cylinders and feeds, and the pressures of clamps and chucks. They reduce air consumption at blowgun operations and prevent accidents caused by chips and dirt being blown too forcibly through the air. Most people don't realize the small amount of air pressure actually required for cleaning. Set your air regulators at a pressure equal to the lowest main line pressure so it will remain constant even though pressure rises during coffee break or other low air-consumption periods. This eliminates fluctuations in machining and other operations controlled by the air.

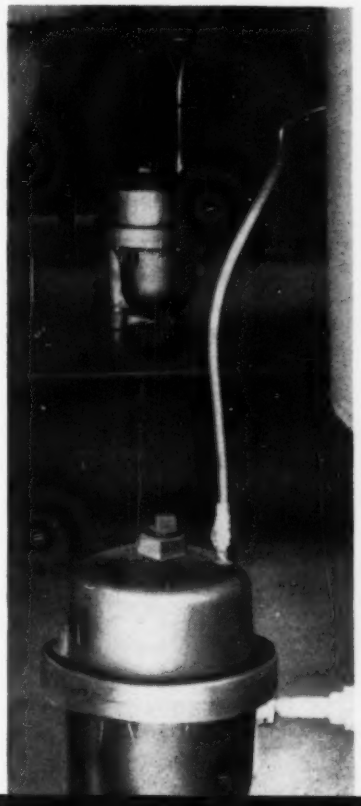
Lubricators are usually needed in a pneumatic circuit that includes air cylinders, clamps, chucks, feed mechanisms and positioners. They keep equipment operating freely, reduce wear, keep packings pliable and coat metal surfaces against corrosion. You can get air-line lubricators that can be filled without shutting off the air line. It's a big advantage to have a sight-flow gage so your operator can see if lubricant is entering air line, and at what rate. Locate the lubricator so fill holes can be reached easily. Although lubricators operate automatically, check them religiously for proper action, adequate oil supply and presence of moisture in the bowl.

Because there are so many small cylinders and clamps operated by air, the ideal lubricator would furnish good oil atomization down to very low air flows. This ideal lubricator would have a petcock in the bowl so any moisture collecting beneath the oil (where the siphon tube is often located) can be drained out. As with other adjustable equipment, a tamperproof knob is usually best.



FILTER UNIT serves as a moisture separator and dirt filter for main air-supply line

AUTOMATIC DRAINS installed on tank eliminate oft overlooked manual draining



Plant

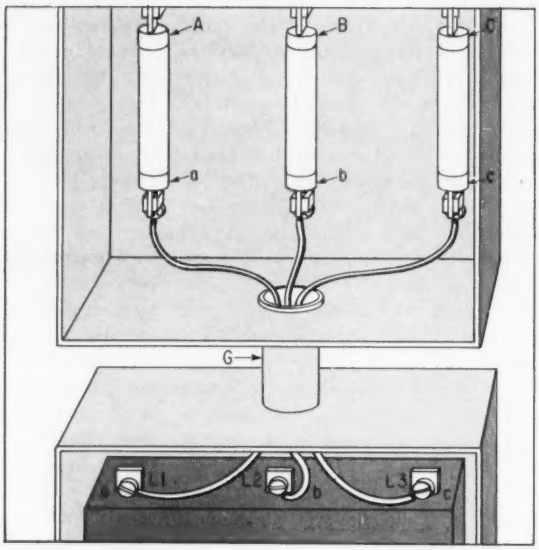
Electrical Fact File

NO. 33: MOTOR TROUBLES

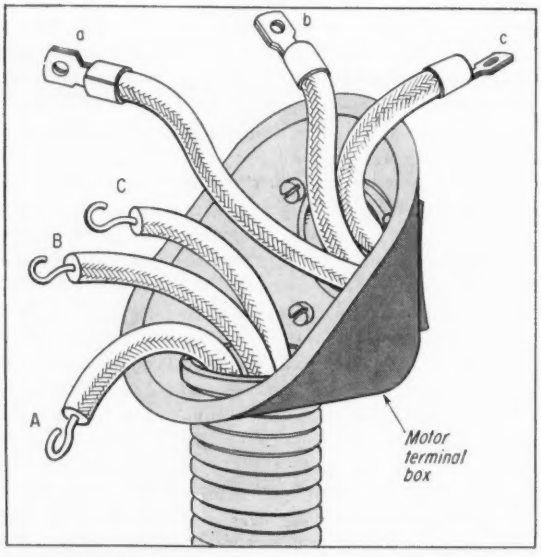
6 tips on trouble shooting induction motors

By NORMAN PEACH, Associate Editor

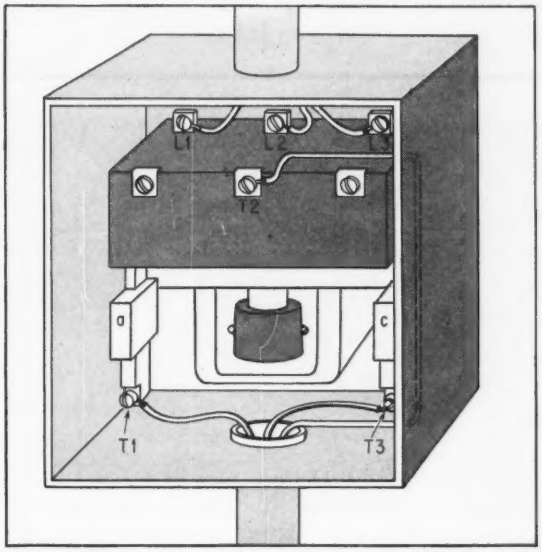
When an induction motor won't start and just groans or shows no sign of life at all, where do you begin searching for trouble? First look for the most obvious (and easily remedied) troubles, being guided by the history of the motor if it's available to you. But tackle the problem systematically. Begin with the power supply and proceed with electrical and mechanical tests that require a minimum of dismantling. If these tests fail to reveal the cause of trouble, go back to the beginning and perform more searching tests, leaving motor disassembly as the last resort.



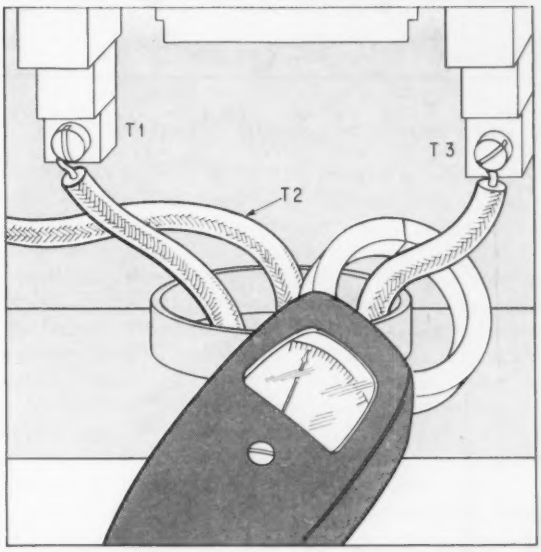
1 CHECK POWER SUPPLY at controller terminals with contacts open. Test lamp should show equal voltages between *L1—L2, L2—L3, L3—L1*. Also see that volts to ground *G* are normal for each phase. Frequent error when testing fuses comes from motor or transformer connected to load side; test across *A—a, B—b, C—c*.



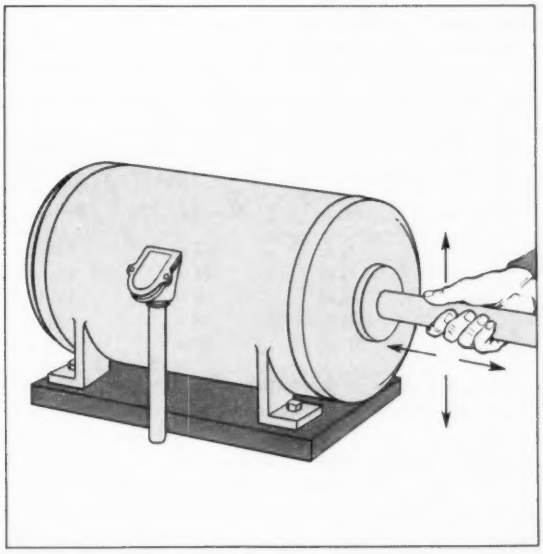
4 MOTOR-TERMINAL TEST isolates troubles in the motor. Short, open or ground in conduit is easily determined. Current test is sometimes more easily performed here. If overload or locked rotor is indicated, make mechanical checks first. An open rotor can often be detected by test with motor in place (*Fact File* No. 23).



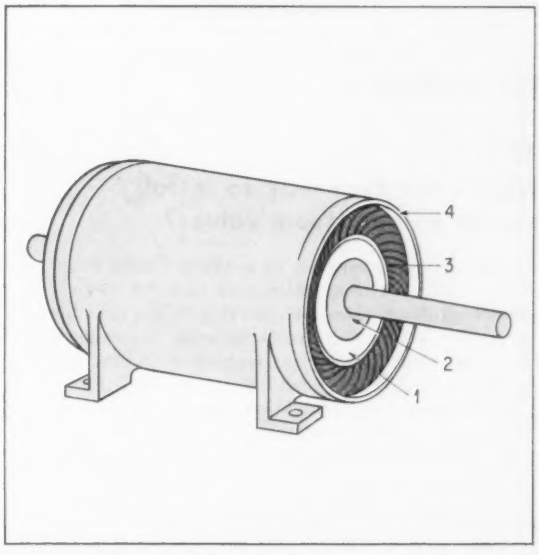
2 STARTER gets checked next. If the magnet works, test for open contacts across *L1—a, L2—T2* and *L3—c*. For possible burned-open thermal element test across *a—T1* and *c—T3*. If magnet doesn't work, look for defective overload relay; if okay, short out start button to see if magnet picks up. Try closing it by hand.



3 CURRENT TEST is easy with clamp-ammeter. Unbalanced currents indicate shorted motor winding. One leg reading zero means open circuit. Balanced high amperes show overload or locked rotor. If clamp-on meter is not available postpone current test; try mechanical tests. Test for ground on *T1, T2, T3* (with the power off).

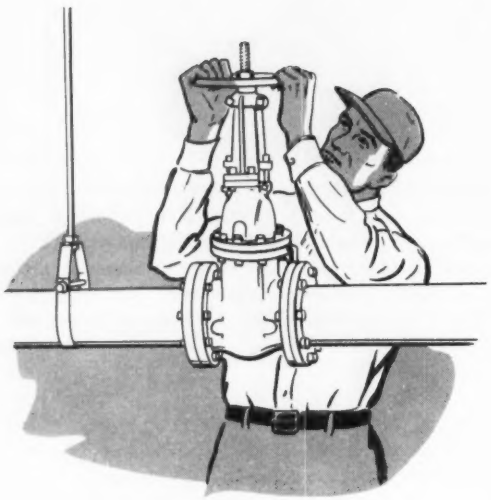


5 MECHANICAL TROUBLE or overloaded machine can usually be spotted with motor in place, though load may have to be disconnected. Test for worn bearings which will give excessive vertical or horizontal play. Rotor or fan may rub in some positions, not in others. If motor seems okay, check driven machine's bearings, etc.



6 DISASSEMBLE MOTOR to find mechanical trouble, determine if rotor is sound *1*. Shaft may be loose *2*, or air gap plugged with dirt or magnetic particles *3*. Stator core may have shifted in frame and resulted in rubbing. Sometimes, if you're lucky, burned-off lead or other repairable winding damage can be recognized.

These **plant problems** could well be yours...



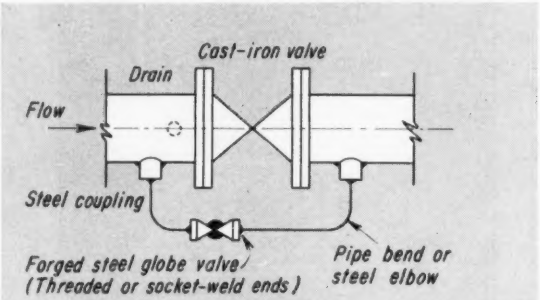
The problem

What's the best way to install bypass on our steam valves?

We plan to install bypasses on a series of main steam valves. Valve body material is gray cast iron of good uniform structure. The line operates at 125 psi. It's our present hope to cut costs by using the original valves and either drilling and tapping or drilling and welding in the nipples needed for conversion.

Before going ahead, I'd like to know if brazing or welding can produce enough heat to warp the valve body? For the weldments involved, is the arc method faster than the gas method? How do all these methods compare in cost? What do others consider the best way to install this bypass?—*TA, November* POWER

The solutions



Note - Use gas-welding throughout. If screw fittings are used (1) omit compound and back-weld threads, (2) Use extra heavy, schedule-80 pipe, ASTM-A-53, lap welded.

Dependability is the prime consideration

Everybody knows that a bypass makes it easier to operate the main valve by permitting the operator to equalize pressure on both sides of the disk. In the case of steam lines, the outlet side can be warmed up slowly before opening the larger main valve. Valve bypasses are an important feature and should be included in the original design. It's much more difficult and even dangerous to drill and tap the body of a cast-iron valve after it has been in service and subjected to the cycles of expansion and contraction. This is true even though the body of a cast-iron valve is better quality than average cast-iron fittings and is often referred to as "semisteel."

Bypasses are recommended on 6-in. valves and up, for pressures as low as 125 psi. Bosses are furnished on these sizes in the mold. They are then drilled and tapped in the shop or in the field before erection.

The following sizes for bypass connection are recommended for main valves on steam lines:

Main valve	Bypass	Main valve	Bypass
4 in.	¾ in.	12 in.	1 in.
5 in.	¾ in.	14 in.	1¼ in.
6 in.	¾ in.	16 in.	1¼ in.
8 in.	¾ in.	18 in.	1½ in.
10 in.	1 in.	20 in.	1½ in.

When a bypass is connected with side mounting on a steam line, it's imperative to have a drain connection on the inlet side of the main valve. It should have an open end in plain view of the operator so he can make sure no water remains in the pipe before the main valve is opened. If there is no drain a horizontal run of pipe will remain half full, even after the bypass is opened. This can severely damage the valve.

Rather than operate on the body of the valves, use the method illustrated above. Cast-iron valves should never be worked on after they have seen service.

For a small job like this one using pipe sizes under

...Here's how *Power* readers would tackle them

BOB MARKS, Assistant Editor

2 in., the cost of making the installation is secondary. Dependability is the prime consideration. The entire line should be made of steel, that is, socket-welding fittings and forged-steel valves with socket-weld ends. If screw steel fittings are used, the pipe should be Schedule 80 extra-heavy Specification ASTM 53 lap-welded. Seamless steel usually isn't available. Gas-welding is recommended. Where threaded connections are used, they should be back-welded. Joint compound shouldn't be used.

P KEARNEY, *New York, N. Y.*

Avoid welding or brazing the valve body

I've had a lot of experience installing bypasses around stop valves. When cast-iron valves are used it's wise to avoid welding or brazing on the main valve body. Local heating can seriously distort the valve body. Unless the valve is thoroughly preheated, the body is liable to crack adjacent to the weld. In general, better results are obtained with brazing since less heat is required than for gas welding. Gas welding, in turn, gives better results than arc-welding. The heat is applied over a greater area, giving more of a preheating effect with less chance of cracking the cast iron adjacent to the weld.

Fortunately, the bypass doesn't have to be put on the valve body itself. It's best to install a separate bypass line around the valve to give the desired control over steam-line drainage and warmup.

J S COLE, *Camden, N. J.*

Why not install bypass in steam line?

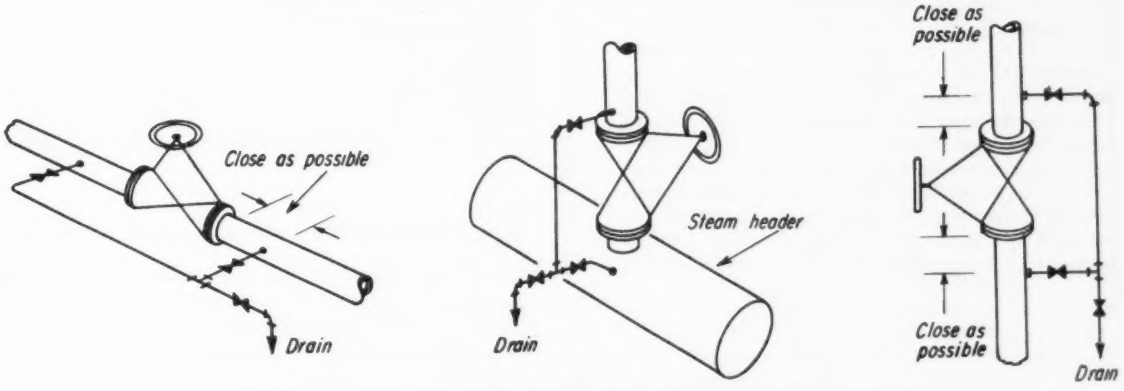
Welding or brazing is the last thing I would think of when installing a bypass on a cast-iron valve. It's relatively simple to drill and tap cast iron. You'll find that most valves have a spot marked on each side and the bottom for this drilling. Brazing presents a warping problem. And you may have trouble getting the valve hot enough. There are some alloy rods available for arc welding steel to cast iron, but I wouldn't recommend welding either. If a speedy job is necessary, why not weld nipples in the line on each side of the valve? The bypass can be completely made up ahead of time and welded to the pipe in a matter of minutes. Holes in the line can be drilled or cut out with a torch.

W A COTTRELL, *Minneapolis, Minn.*

Weld or braze for a tighter steam system

Brazed or welded joints are preferred to screwed joints. A properly made fused joint avoids the potential leak problem presented by screwed fittings. This is particularly true for steam systems subjected to alternate heating and cooling, with condensate accumulating during shutdown. Liberation of soluble gases from the condensate may cause corrosion at the threads and lead to leakage.

H B WAYNE, *Woodhaven, N. Y.*



Advantages of 3-valve bypass justify the added cost

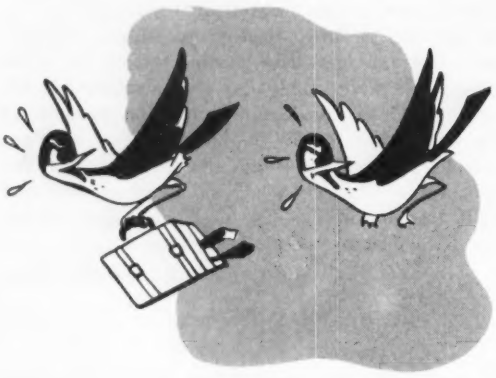
TA doesn't need to tap and drill on the main valve body. Valve can be bypassed by drilling the pipe and welding a steel half-coupling to make the bypass shown above.

This arrangement has many advantages compared to a single-valve bypass. On vertical lines, condensate on top of the valve can be drained. If a valve leaks, pressure on the section of pipe downstream can be released. When a bypass valve leaks, drain valve will prevent pressure buildup downstream from the valve. The one disadvantage of this arrangement is the increased expense of three valves compared to one.

J MECSERY, *Hershey, Cuba*

Turn page for new problems ►

More **plant problems**



The problem

How do you keep swallows away from electrical substation buses?

In our electrical substation we have a little problem with migratory swallows, which we haven't been able to solve up to now. At night swarms of swallows roost on both high- and low-voltage buses, depositing large quantities of excrement that eventually develop into flashover. We've tried to discourage them by spraying oil and steam into the air adjacent to the substation. But oil is too messy and steam doesn't have any effect. An air blower was also tried in another unsuccessful attempt to discourage their roosting habits. How can we solve this problem? Undoubtedly many readers have faced the same situation.—*JJO, November* POWER

The solutions

Want some help on plant problems? Send us any of your design and operating headaches. We'll put *Power* readers to work on them

Record the noise of captured swallows

JJO can solve his problem by first catching several swallows unharmed, then recording the sounds made by the captured birds on a tape recorder. The next time the swallows come to roost, a high-volume playback of this recording will clear the area of roosting birds. We've had good success with this method on starlings.

W F POPP, *Harriman, Tenn.*

Mount birds of prey near substation

Although I'm unacquainted with *JJO*'s swallows, several ideas come to mind. In your area there certainly must be several birds of prey that lunch on swallows, such as hawks or owls. Mount one or two of these on a pole in the immediate vicinity and the chances are that the swallows won't even come close. You might also try a couple of smudge pots such as are used in orchards.

D L COCHRANE, *Cambridge, Minn.*

Try a special roost with spiked shaft

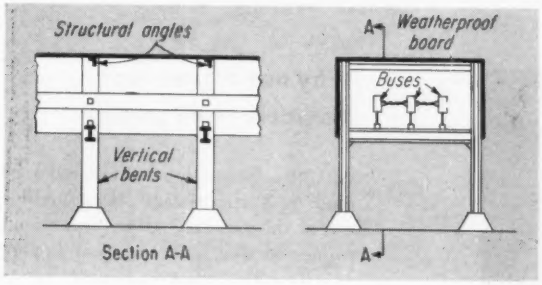
Some rural electric lines in the southwest had a lot of trouble with buzzards causing short circuits. This problem was solved by building a special roost on the end of a balanced lever with sharp prongs under one end. Whenever a buzzard sat on the roost his weight pushed it down over the spikes which came up through the roosting bar to hit him where it does the most good. I'm sure that a similar rocking shaft can be rigged so that the weight of a few swallows will trip it. It might also be worth while trying a strong spotlight close to the substation buses.

I A BUTCHER, *Cincinnati, Ohio*

Brightly colored balloons worked for us

We have experimented with many ways of eliminating obnoxious birds from buildings and equipment. Probably the most aggravating problem was that of scaring away hordes of pigeons that infested a courthouse to the extent that lice actually invaded the judges' chambers. Plastic windmills helped for a while. Then rubber snakes were put on the wide window ledges behind the ornamental louvers. But this too only worked for about a week. We also tried a modified type of bird lime, but without long-term success. The windmill idea was then modified by using brightly colored balloons inflated with helium, and has worked very well. Pigeons, starlings and swallows stay away.

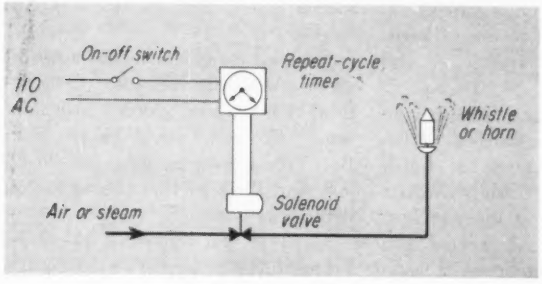
P C ZIEMKE, *Clinton, Tenn.*



Enclosing the bus will give protection

One way to prevent flashover from bird excrement is to use an enclosure of steel or aluminum construction similar to that used for an isolated phase duct. Each bus is then protected from the elements and is accessible for inspection and maintenance. An alternate scheme, above, uses standard materials of construction. Underside of the bus runs is still exposed to the atmosphere, allowing ventilation and air cooling. *JJO* doesn't indicate voltage level or bus arrangement. With this information, the structure can be designed to meet Code requirements.

H B WAYNE, *Woodhaven, N. Y.*



Hook up this automatic air whistle

JJO was pretty close to solving his problem of how to keep swallows away. He should try a blast from a steam or air whistle instead of just spraying steam or blowing air. With a repeat cycle timer and a solenoid valve he can adjust the duration and the interval between such blasts.

A AWAN, *Brooklyn, N. Y.*

Even some bird psychology might help ???

I suggest *JJO* post an illuminated sign with the following wording: *Capistrano*—½ mile south. Possibly the swallows will decide to continue on.

J E MEYERS, *Harriman, Tenn.*

Your February problems

How can water hammer in feedwater lines be prevented?

We have two centrifugal boiler-feed pumps controlled by a float switch on the feedwater-storage tank. Boilers are shut down at night and started in the morning. The pumps start and stop about every four to eleven minutes. After about two hours operation we get water hammer in the feedwater lines. We've already had to replace pipe and fittings several times. The hammering stops when cold water is added to the storage tank, but this calls for too much boiler blowdown. What can be done to prevent or absorb this shock on our feedwater lines?—*DAW*

What's the best way to modernize our electrical distribution system?

We are thinking about modernizing the electrical-distribution system for our strip-mining operations. Load is strictly power for mine dewatering. We plan to install the grounded-phase delta circuit using new outdoor transformers designed for direct feed through to the service wires. Direction is reversed by feeding through opposite end of the transformer. These models have a transformer ratio twice the multiplying ratio when used as a 3-wire transformer.

The top conductor will run as phase "C" in the pole line construction and be phase grounded to the primary neutral and grounding connections at the transformer bank. So all the center taps on the transformer must be isolated from ground by removing the transformer straps.

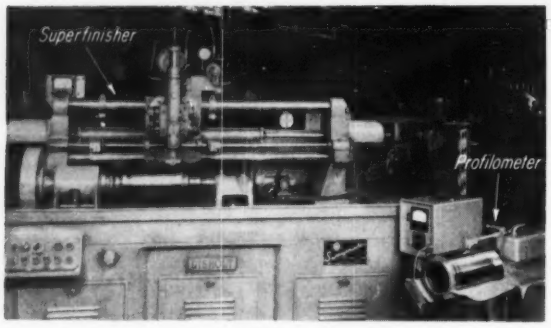
We don't anticipate trouble with the new load wiring, but the insulation is a question mark on the old installation. So caution must be exercised before converting to grounded-phase power. Perhaps some reader with recent experience can tell us how to conduct a megger program with minimum downtime.

Since the center-tap grounding of one transformer in existing service will be eliminated, we plan to identify the grounded phase either by its position in aerial construction or by colored insulation. We'll use it as the interconnecting grounding conductor for primary and secondary grounds without running a fourth wire. In the case of equipment grounds we'll run a fourth wire between motor frame and switchgear on the supply side to prevent loss of ground when the starter is open.

Improved fuse coordination is anticipated because of the grounded service with maximum voltage (phase to phase) from ground to hot wires. We would like to have the comments and suggestions of POWER readers on our projected conversion plans.—*WA*

Sit down right now and answer one or both problems. We'll pay extra for answers with photos or sketches

Timely **practical ideas** to help solve



Superfinished engine, compressor parts cut maintenance

Engine and compressor wrist pin, piston and crosshead assemblies are critical because they are under terrific loading. So finest finishes on mating surfaces help to eliminate wear and control size and noise.

To superfinish, rough turn, bore and machine. Make allowances for grinding and superfinishing. Next carburize, harden and draw to hardness specifications. Rough and finish grind from 12 to 15 micro-in. This operation removes all distortion; parts are absolutely true. Amount of stock left for superfinishing varies with diameter, but generally runs from 0.0003 to 0.0005 in.

You can superfinish in two ways. Small parts from ½- to 1¾-in. dia x 6-in. overall length are finished by the centerless method. Here an attachment on superfinishing machine allows the parts to rotate between two rollers while the finish stone contacts the part for finishing operation.

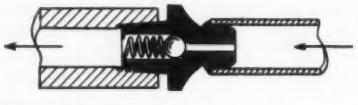
Second method is between centers, photo, and is for larger diameters. Same method is used for finish operation except that two stones are used instead of one. Stones mounted in head of machine are made of Alundum and vary in grit sizes from 500 to 700, depending on degree of finish needed. Usually a 600-grit stone will remove about 0.0002 in. per side and produce finish from 4 to 6 micro-in. on carburized, hardened surface.

Degrees of smoothness can be obtained by varying the size, stone hardness and bond. You must experiment with each application on the material to be finished for needed results. We found that the most practical solution.

When superfinishing, use a flood of coolant to wash away the grit and metal particles. Use kerosene fortified with a sulfur, chlorinated-base additive, of one part to ten of kerosene. This solution speeds up the cutting operation.

Photo shows large diesel-engine wrist pin being superfinished. Each pin is surface inspected for finish with a Profilometer. Finish is checked longitudinally which is the roughest portion of the pin. Inspected pin must not exceed six microns. Checking the wrist pin at opposite direction, finish must not exceed four microns. More and more maintenance shops are gearing up for superfinishing, which pays off handsomely.

W J Reich, *Harrison, N. J.*



Handy check valve

A small check valve made from a grease fitting can be a very useful item. One end can be soldered into the line, the other threaded. The spring and ball prevents reverse flow.

C McLaughlin, *Rockaway, N. Y.*

Why not a governor disk-driven oil pump?

At times forced lubrication must be used on a single-stage steam turbine where the mechanical governor isn't connected to a reduction gear having an oil pump. So, you have to use a longer shaft and put a gear-driven oil pump either at the steam- or exhaust-end bearing case. This increases the length of the turbine and causes other problems.

As an alternative solution, use a spiral gear, cut directly on the rim of the governor disk, to drive the oil pump. This eliminates the special shaft and extra length. All you need is a special governor disk and a steam-end bearing case incorporating a gear oil pump. The rest of the turbine can be standard.

The right quantity of oil is obtained by using a large pump at slow speeds and smaller pumps at higher speeds.

Such an arrangement has not been used — probably because designers think the surface speed of the governor disk gear would be too high. But, take a look at the example below, and I'm sure that you will agree with my reasoning.

Many of you remember the Rigid Frame turbo-generators built by GE. A cut is shown on page 581, volume I, of Lowenstein's *Translation of Stodola*. Cut shows that this was a 3-bearing unit with the governor and oil pump located at the center bearing. The units operated at 3600 rpm and on overspeed tests at 10 to 15% above the regular operating speed.

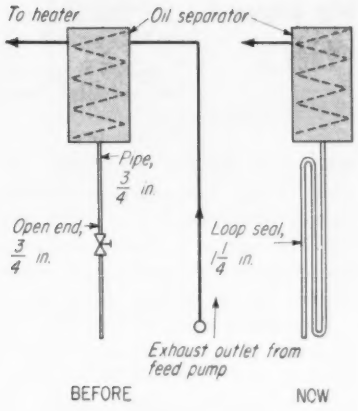
Larger units had a 10-in. diameter shaft at this point and a 11.9-in. pitch-diameter worm or spiral gear mounted on it.

From this, you can see that a governor disk gear, which is much smaller, could be run at a much higher rpm than the above and still not exceed the surface speed at which these units were successfully run. I'd like to hear from you readers.

K MacDonald, *Wellsville, N. Y.*

your tricky design and maintenance problems

STEVE ELONKA, Associate Editor



Loop stops oil

Two 7½x5x6-in. duplex boiler-feed pumps were installed—one as standby. Exhaust steam from pump was delivered to the deaerating feedwater heater.

An oil separator of ample capacity was installed to remove the lube oil from the steam before it reached the heater. But, at times, oil found its way into heater and finally into boiler.

Sketch shows how the oil drain from the separator was installed, and why it let oil get into the heater.

Since there was no trap or loop to prevent steam from blowing through at heater pressure, the hand valve was partly closed. At times the valve would become plugged and stop the flow of oil and condensate from the separator. If not discovered early, the separator would fill with condensate and oil, which would carry over with the exhaust to the heater.

A 1¼-in. pipe loop of the correct length to prevent blowby at 5 psi in the heater was installed. That not only solved the problem but eliminated the hazard of the shutoff valve.

C T BAKER, *Atlanta, Ga.*

Have you sent . . .

in your *Biggest Boner*. It's worth $15 when published. We all make them; like to tell about the other guy's. But are we big enough to tell about ours so our colleagues learn from them?

What would you have done?

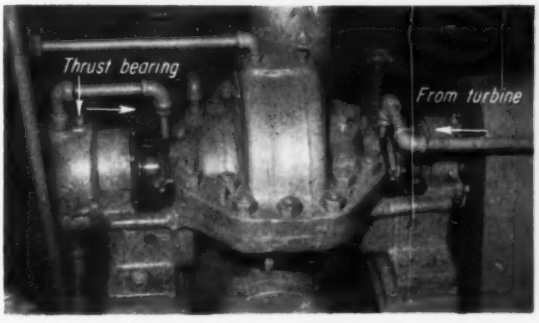
Our hydroelectric plant had a turbine runner that had to be inspected for pitting on the underside. But we couldn't get the water down because the stop logs in the tail-race side were faulty. Besides, time was at a premium. The water was 6-in. below the underside of the manhole. That gave us a man-sized headache.

First we considered putting 8x8 timbers through the manhole, nailing on cross strips and making a raft to support the men. But this also would take time, for we couldn't hold the tail water which was rising steadily. So our problem called for action.

Someone remembered a war-surplus store in town where they had some old Air Force inflatable rubber rafts. It took only about 15 minutes to dash uptown, get a rubber boat, shove it through the manhole, inflate it and make the inspection.

We have since used that stunt several times, each time with unusually good results. What would *you* have done?

L MCWILLIAMS, *Shawinigan South, Que.*



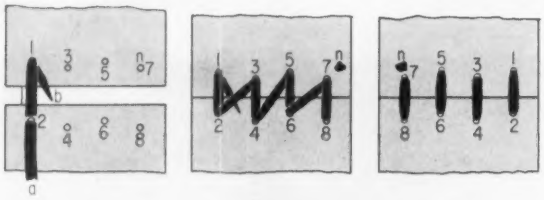
Cooled packing lasts three times as long

Some time ago we piped cooling water from our feed pump thrust-bearing and from a turbine bearing to the feed pump's stuffing boxes, photo, above. As a result our packing lasts three times as long.

I know that many plant operators know all about this, but few do it when they have packing problems. Results are so good that we wonder why we didn't do this long ago.

F E ZIEGELMANN, *Fullerton, Calif.*

Turn page for more Practical Ideas ►



Use this scheme for lacing flat leather belt

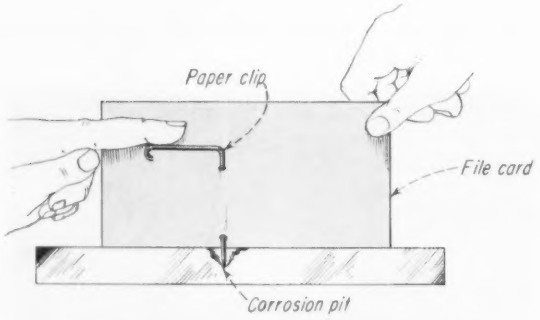
Some of us still use old reliable flat leather belt drives. Splicing them can be an irksome task. Large belts get the benefit of formal tapered and cemented jobs while the rank and file are still spliced with rawhide.

Be sure that ends of belt are cut exactly at right angles to the sides. Use a square and hold it on the belt until you have it cut half way through. Punch two rows of holes in each end of the belt, sketch. Holes in both sides of belt should be exactly opposite. Use a punch in making lace holes in the leather and an awl in fabric belts. Make holes slightly smaller than width of lace.

Put stiff tips on the lace by toasting the ends in a match flame. Turn the lace over as you toast it to prevent it from warping. Be sure that the lacing is put in tight at uniform tension, so the belt won't pull crooked. Lace with flesh side up, as shown in sketch.

Put lace down through 1, up through 2, down through 1, up through 2, down through 3, up through 4, down through 5, up through 6, down through 5, up through 6, down through 7, up through 8, down through 7. Punch a hole with an awl and fasten the lace at *N*.

P C ZIEMKE, *Clinton, Tenn.*



Make this handy depth gage

We often want to know the penetration of small-diameter corrosion pits in tubes and metal plate. Expensive needle-point depth gages are twisted after a few applications. Most calipers are too blunt to reach down into crater-like pits.

An accurate, throw-away depth gage can be made from a paper clip or common pin, a 3x5 file card and a machinist's rule, as sketch shows.

Just use the clip to puncture two holes in a straight line at right angles to one edge of the card, sketch. To measure depth of pit, place edge of card firmly over metal surface. Then push clip down into pit, remove card and measure length of clip extending from card edge with machinist's rule.

A J RISTAINO, *Annapolis, Md.*

My biggest boner

When you readers learn that my work with high-pressure boilers started 30 years ago as a stoker and that I sailed as a marine engineer, this boner should really plug your Charley Noble (galley stove pipe).

After being away from steam for 18 years while sailing aboard motor ships, I started ashore in a rubber plant as fireman, in charge of the 11 to 7 am watch. Two boilers were hrt, other was watertube express. Hrt's were hand controlled and express boiler had latest automatic combustion controls. We fired bunker C.

About 2 am on my fourth day, I returned from the pump room. A check of the automatic control board showed that the air-flow recorder had settled to a steady line and wasn't fluctuating.

Firing rate for the 45,000-lb-per-hr load was normal. Steam pressure was holding at 225 psi. Fires were a little yellow, but not smoking.

All the damper control boxes indicated that dampers were open at correct proportionate settings. Being unfamiliar with (and therefore afraid of) automatic combustion controls I was in a sweat because I didn't like shutting the plant down my first week on the job.

After a few minutes the stack temperature started to drop. I shut the fires down for about 45 minutes. The chief and I found that a pin had fallen out of the uptake damper linkage on top of the boiler. A cotter key had dropped out of the pin. Then the connecting arm from the control box to the damper shaft had stuck between two steam pipes, holding the damper indicator at the open position.

I could have avoided shutting down if I had gotten a working knowledge of automatic boiler controls when I took over the job.

M H WAITE, *Wilton, Conn.*

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Graduate Power Engineer with Mechancal Engineering or Electrical Engineering Degree for Industrial power assignment in large chemical plant located Gulf Coast area. Minimum of 5 years supervisory experience or related duties in steam power operations. Salary commensurate with experience. P-9609, Power.

POSITIONS WANTED

Grad. M.E. Reg.—Age 36, 15 yrs. exp. all phases marine and stationary steam power work. Supervisory position desired. PW-9233, Power.

Chief Engineer, age 38, technical education, 14 years experience in the operation, maintenance, construction, and plant betterment of turbo-electric power plants. PW-9551, Power.

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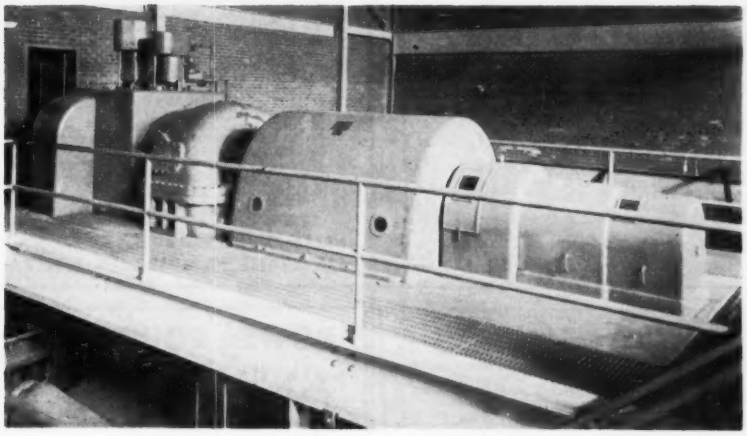

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25 PSIG
Surface Condenser and
Auxiliaries
Switchboard complete
New 1949

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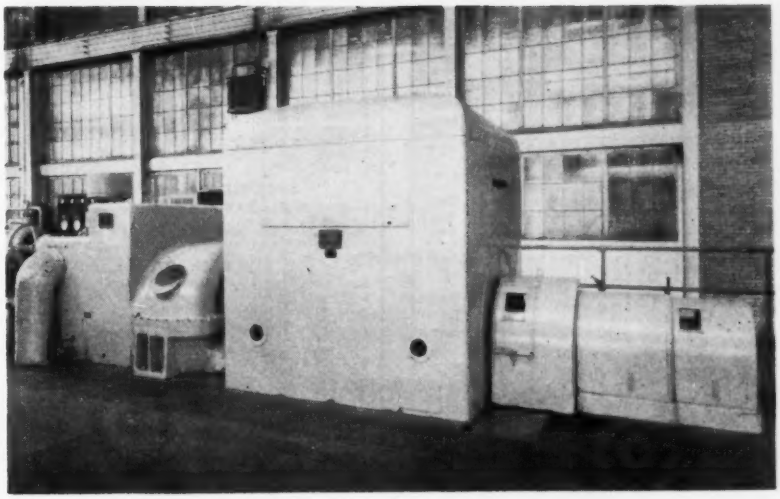

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A. C. MOTORS—3 ph. 60 Cy.

SLIP RING

Qu.	HP	Make	Type	Volts	Speed
1	1750	G.E.	M-579BS	4600/2400	1800
1	1500	G.E.	MT-6	6600	1187
1	800	Whse.	CW	550	1776
1	700	Al. Ch.	D.P.	2300	500
1	600	Whse.	CW-432D-18	440	1778
1	500	G.E.	MT-412	2300	450
1	500	Whse.	CW	550	250
1	350	Cr. Wh.	SIZE-718R	203/406	1763
1	350	G.E.	IM-17A	440/2200	720
1	350	Whse.	CW-1039C	440	720
1	250	G.E.	MT-424Y	4000	257
1	250	Cr. Wh.	SIZE-299	2300	356
1	250	A.C.		550	600
1	250	G.E.	MT-563Y	440	575
1	250	Whse.	CW-1010	2300	435
1	200	Whse.	CW-874D	220	885
1	200	G.E.	IE-13B	220	1760
1	200	G.E.	IM	2200	880
2	200	G.E.	IM	2200	435
2	200	Whse.	CW-890	2300	1775

SQUIRREL CAGE

1	800	G.E.	KT-573	2300	1180
1	500	G.E.	FT-559AT	2300	3600
1	550	Whse.	CS-1115	2300	900
4	500	Whse.	CS-1216	2200	500
3	500	G.E.	KF	2300	3600
2	450	Whse.	CS-1420	2300/4150	354
2	400	Whse.	CS-7151-610H	6600/4000	3565
1	400	G.E.	LK	2200	600
1	300	Whse.	CS-1002	2300	600
1	200	Whse.	CS-963H	2300	1175/875
1	200	G.E.	KT-557	440	1800
2	200	Whse.	CS-8558	220/440	1750
1	150	G.E.	CS	440	550

SYNCHRONOUS

1	7000	G.E.	ATI	2240/6600	600
1	4350	C.W.	3501-SL	13800/6900	514
1	3500	G.E.	TS-8438P	2300/4000	360
3	1750	G.E.	ATI	2300	3600
1	1750	G.E.	TS	2300	900

M-G SETS—3 PH. 60 CY.

Qu.	K.W.	Make	RPM	DC Volts	AC Volts
2	2100/1750	G.E.	514	250/350	2300/4600
1	2000	G.E.	514	680	2300/4600
1	1500	G.E.	720	600	6600/13200
1	1500	G.E.	600	600	2300/4150
1	1000	G.E.	900	260	6600
1	1000	G.E.	720	600	6600/13200
1	750	G.E.	720	275	6600/13200
1	500	Whse.	900	125/250	440
1	350	G.E.	900	125	440/2300/4160
2	300	G.E.	1200	250	2300
1	250	Whse.	1200	275	2300
1	200	El. Mfg	1200	250	2300/4600
1	200	Whse.	1200	600	2300
1	200	Whse.		550	2300
1	200	G.E.	1200	250	550/2300
1	200	Cr. Wh.	1200	250	440
1	150	Whse.	1200	275	2300
1	100	G.E.	1200	250	4160/2400

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	300	G.E.	175/200# Cond. 480/2300 V.
1	1000	G.E.	150# no Cond 2400 V.
1	4000	G.E.	400# surface condenser 2400/4150 volts.

TRANSFORMERS

Qu.	KVA	Make	Type	PH.	Voltages
2	3333	Whse.	OISC	1	13800x2300
3	1000	G.E.	OISC	1	13800x460
2	750	G.E.	FUR	1	4800x35/55
3	500	KUHL	OISC	1	13600x6000
1	225	Marcus	Air	3 auto	208/220
3	100	G.E.	OISC	1	22900x2400/4160Y
3	100	L.M.	OISC	1	4160/7200Y/240/480

FREQUENCY CHANGER SETS

Qu.	KW	Make	Freq.	Voltage
3	6750	G.E.	60/25/60	13200/13200
1	5000	G.E.	60/50/60	11000/6600
2	2500	G.E.	25 cy/62.5	2300/2300
1	500	Al. Ch.	25/60	11000/2300
1	200	G.E.	60/3000	440/880

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D.C. MOTORS WITH M.G. SETS & CONTROLS
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1—2250 HP Elliott 230 V. 200/300 RPM DC Motor with 2400 KW GE MG Set. 300 V. DC 2300/4600 V. 450 RPM 3 ph. 60 cy.
1—1375 H.P. G.E. MCF. 415 V. 1300 RPM D.C. motor with 1160 KW G.E. MG Set 415 V DC, 2300/4000 V. 720 RPM 3 ph. 60 cycle.
1—1200 HP G.E. MPC. 600 V. D.C. Motor, 450 RPM, and 1000 KW, G.E. M-G Set, 600 volt DC with 1400 KP, .8 PF, Synch. Motor 13200/6600 volt, 3 ph. 60 cy.

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SLIP RING MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Speed
500	4000/2300	G.E.	900
450	440	Whse.	514
450(2)	2300	G.E.	900
400	4000/2300	Whse.	720
300	4000/2300	G.E.	720
300	2300	G.E.	900
300	440	G.E. (hoist)	600
300	440	Whse.	3600
225	4000/2300	G.E. (hoist)	600
200	2300	G.E.	600
200	2300/440	G.E.	720
150	220/440	Whse.	720
125	2300	G.E.	600

AC GENERATORS or SYN. MOTORS, 60 Cy.

H.P.	Volts	Make	Type	R.P.M.
400	2300/440	G.E.	ATI	720
300	2300/4000	G.E.	TS	720
300	2300/440	G.E.	TS	1200
200	2300/440	Whse.	G	1200
150	440/220	Whse.	G	1200
150	440/220	G.E.	TS	900
125	440/220	Whse.	HR	400

SQUIRREL CAGE MOTORS

500	2300/4000	Elliott	SC	1800
350	2300/4000	G.E.	SEDP	3600
350	2300/440	G.E.	IE-K	1200
300(2)	2300	G.E.	FT	3600
300	2300/4000	L. Allis	FS	1800
300	2300/400	G.E.	KT	600
200	440/220	G.E.	KT	1800
200	2300	G.E.	KT	1800
200	2300	Cent.	TEFC	3600
200	440/220	G.E.	KT	720
200	2300/440	G.E.	IE-K	1200
150	440	Whse.	X-prf.	3600
150	2300	Al. Chal.	KT	720
150	440/220	G.E.	TEFC	720
150	2300/440	G.E.	AR	1800
150	2300/440		KT	600
150	2300/440	G.E.	FT	1200
125	2300/440	G.E.	K	600
100(3)	4000/2300	L. Allis	OK	1200
100	2300	Cent'l.	TEFC	3600
75(2)	440	Wagner	TEFC	1800

CIRCUIT BREAKERS, 3 Pole

1—6000 Amp., Whse., 600 V., Air, New
1—3000 Amp., R-Smith, 600 V., Air, New
4—1600 Amp., DA-50, Whse., 600 V., Air
6— 600 Amp., R. Smith, 7.5 KV, Sol. oper.
1— 400 Amp., R. Smith, 7.5 KV, outdoor, New

D. C. MOTORS

H.P.	Volts	Make	Type	Speed
200	230	Cr. Wh.	CMC	1200
150	230	El. Dyn.	B/brg.	600
125	230	G.E.	CD	600
60/75	230	G.E.	CD	500/1500

MOTOR GENERATOR SETS

KW	Make	Input V., AC	Motor Type	Output V., DC
250	Whse.	440	Syn.	250
125	G.E.	440/220	Sq. Ca.	125
125	G.E.	440	Sq. Ca.	250/125
100	G.E.	2300/440	Syn.	250
75	Cr. Wh.	440/220	Sq. Ca.	240/120
65	G.E.	2300/440	Sq. Ca.	250

TRANSFORMERS 60 Cy.

1—500 kva, Al. Ch., 2400/4160Y—600 volts, 3 ph.
3—500 kva, G.E., 13800—2300 V.
3—333 kva, G.E., 2400-240/480 V.
3—333 kva, American, 2400—240/120 V.
3—250 kva, Al. Ch., 13,800—240/480 V.
1—200 kva, Al. Ch., 6900—220 V., 3 ph.
1—200 kva, G.E., 2400—120/240 V., Pyr.
3—200 kva, Mot., 13,800—2300 V.
3—200 kva, G.E., 13,800—480 V.
3—150 kva, Al. Ch., 2400—220 V.
3—150 kva, Al. Ch., 440-220 V., dry New
3—150 kva, G.E., 13,200—2300 V.
3—100 kva, Whse., 4800/2400-240/480 V., Dry
3—100 kva, G.E., 2400—120/240 V., Pyr.

GASOLINE—ENGINE GENERATOR SETS

2—35 kva, 900 R, 220 V, 3 ph. conn. LaRoi, 6 cyl.
1—31 kva, 1800 rpm, 240/480 V., 3 ph., Ford, 6 cy.

only partial listing

STEPHEN HALL & CO.
HARRY J. RICE, Pres.
625 ADAMS ST., HOBOKEN 2, N. J.

TRANSFORMERS—60 CYCLE

Qu	KV	Make	Type	Phase	Voltages
2	3000	Moloney	TCR	3	7200/6600-4160/2400
2	750	G.E.	K	1	4600-120/240
1	750	Niagara	Air Cooled	3	2400/4160-480/277
1	300	Penna.	(Askarel)	3	12470Y/7200-240
2	250	G.E.	H Pyranol	1	4800/8320Y/120/240
2	250	West.		1	2300/4600-230/460
3	200	G.E.	HS	1	2400/4160-240/480
2	200	G.E.	H	1	7200-13600-220/440
1	150	Etsler	OA	1	4160-240/480
3	100	G.E.	H		2400/4160-240/480
1	50	G.E.	Air Cooled	1	440/220-220/110
3	50	G.E.	HS	1	2400/4160-240/120
1	50	Amer.	Abestol	3	4160-120/208Y
5	50	G.E.	HS	1	2400/4160-240/480
4	25	West.	Hyperail	1	2400/4160-120/240

MOTOR GENERATOR SETS

Qu.	KW	Make	Speed	DC	AC
3	60	E.M.	1200	125	220 v. Syn.
1	75	G.E.	1200	125	2300/4160 Syn.
2	100	West.	1200	250	2300/4160Y Syn.
1	175	West.	1200	125	4150 Syn.
1	300	G.E.	1200	250	2300/4160Y SR
1	300	G.E.	1200	250	440 Syn.
1	1000	West.	720	600	2300/4160Y

ENGINE GENERATOR SETS

1—Hercules Gas HXE 62.5 KVA Westghe 3/60/480—1500
1—Wisconsin Gas (Air) PE-99 7.5 KVA Master 1 or 3/120—2200 r.p.m. NEW.

SLIP RING MOTORS

Qu	HP	Make	Speed	Type	Volts
2	40	West.	690	CW	220/440
1	60	G.E.	1800	MT	220
1	75	G.E.	600	IM	440
1	100	West.	1800	T.E.F.C. B.B.	220
3	150	Allis-Ch.	1800	AY-RW	2800
1	200	West.	514	CW	440
1	250	West.	600	CW	440
1	350	West.	1800	CW	2300
1	500	G.E.	450	MT	2200
1	500	G.E.	1200	M569Z	2300/4160Y

D.C. MOTORS—230 VOLTS

Qu	HP	Make	Speed	Type
1	75	Star	1200	SR 60 L B.B.
1	92	West.	425/1000	173 FR
1	350	G.E.	1200	Pedestal

SQUIRREL CAGE MOTORS, 3 PHASE, 60 CYC.

1—275 HP, 1180 RPM G.E. Type KT 559BS 2200V
2—200 HP, 1790 RPM, G.E. Elec. KF, TEFC, 2300V
1— 40 HP, 1750 RPM Wagner 444 440V T.E.F.C.
1— 25 HP, 1170 Howell 405 440V T.E.F.C.

MOTORS—SYNCHRONOUS—3 ph. 60 cy.

125 HP 600 RPM G.E. Type TS 2200 V.
125 HP 900 RPM G.E. Type TS 4800 V.
150 HP 1800 RPM G.E. Type TS 220 V.
325 HP 900 RPF West—2300 V.
300 HP 720 RPM Elec. Machinery t.e.f.c. 2300 V.
400 HP 450 RPM Westinghouse Type HR 440 V.
1000 HP 360 RPM Westinghouse Ped. Type 2300 V.

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300 KW G.E. Non-C Turbo Generator 3/60/480-150# 5-10# BP 3600 RPM

3000 KW G.E. Condensing Turbo Gen. 2400/4150V, 400#, 725°, 3600 RPM

45000# Combustion Engineering BOILER 450#, 750°TT, oil fired

509 HP Babcock & Wilcox BOILERS (3) 200# sect. header, oil fired

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BOILERS

4—Keeler 200 HP, 160 psi, water-tube, w/acc.

COAL PULVERIZERS

1—Babcock & Wilcox #32E, 75 HP
1—Raymond 6-roll mill, 66" dia., 200 HP
3—Robinson #13 Sawtooth Crushers

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13750 KVA consisting of (11) 1250 KVA Rathbun Jones NATURAL GAS ENGINE GENERATORS 3/60/2400-4160V. with Switchgear.

1875 KVA TURBINE—400 PSI 700°F. Condensing, 2300 V. GENERATOR, 25000#/hr. 450 PSI BOILER; include all auxiliaries, & 25 TON CRANE.

2500 KVA TURBINE 600 PSI, Extracting 160 PSI, B.P. 30 PSI; 480 V. GENERATOR; 75000#/hr. 650 PSI Oil fired BOILER with complete accessories.

(2) 12500 KW TURBINE 260 PSI Condensing with (3) 1300 HP B&W Sectional Header BOILERS Oil fired, Complete.

NEW BOILERS

122,500#/hr. 565 PSI @ 850°F.
44,500#/hr. 450 PSI @ 735°F.
35,000#/hr. 285 PSI @ 577°F.

Complete units including Superheaters, Economizers, Fuel Oil Burners, Soot Blowers, valves and fittings.

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540 KW—TURBO GENERATOR, 200 PSI 120/240 V. D.C.

200 HP—BOILERS, 160#—Stoker

175 HP C.E. Pkg BOILER, 275# Oil

6000 KVA — TRANSFORMER OISC 44000/4160 Volt

500 KVA — TRANSFORMERS, OISC (6), 66000/480 Volt

D-17000 Cat. Diesel POWER UNIT.

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1—300, 1—200 KVA, 3/60/4160-240 Wagners, ITE type HPB Outdoor Unit Substations.
2—250 KVA, 1/60/2400-240/480 Moloney, OISC, type YC, W/taps.
1—250, 4—150 & 2—100 KVA, 1/60/4160-120/240 Whse. Inerteen w/taps.
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5—25 KVA, WHSE. 1/60/2400—240/480 OISC.

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SQUIRREL CAGE MOTORS NEW AND GUARANTEED REBUILT

HP	Make	Type	Speed
500	L.A. B.B. Splash. 440 Volt	FX-146S	3600
400	L.A. B.B. Splash.		1800
400	West. S.B. Open	CS	900
400	West. S.B. Splash 2300 Volt	CS-398	720
300	G.E. S.B. Open	IK	1800
300	G.E. S.B. Open	IK	900
300	G.E. S.B. Open	IK	720
300	West. S.B. Open	CS-1002	600
300	Reliance. B.B. Splash	AA-5085	600
250	G.E. S.B. Open	KT	1800
250	L.A. B.B. Drip.	OGX-117	1800
250	G.E. S.B. Open 2200 v	IK-16	1200
250	G.E. S.B. Open	IK	1200
250	G.E. S.B. Open	IK	900
250	G.E. S.B. Open	IK	720
200	G.E. B.B. Drip	K-6325	1800
200	Cont. T.E.F.C.B.B.	NP-686C	1800
200	L.A. B.B. Open	OS-116	1800
200	G.E. S.B. Open	IK-15	1200
200	G.E. S.B. Open	IK-15S	1200
200	G.E. S.B. Open 2200V	IK	1200
200	L.A. B.B. Drip.		1200
200	G.E. S.B. Open	IK	900
150	West. TEFCBB XP	CS-773.6	3600
150	G.E. TEFCBB	K-6328	3600
150	G.E. TEFCB XP	K	3600
150	Wst. S.S.B. Open	CS-781C	1800
150	G.E. TEBB	K	1800
150	West. S.B. Open 2200V	CS	1800
150	G.E. S.B. Open	IK	1800
150	West. B.B. Open	CS-771C	1800
150	Marathon. B.B. Drip	TDA-584	1800
150	G.E. B.B. Open	KT	1200
150	Cont. T.E.F.C. B.B. New		900
130	G.E. S.B. Open	KT-558	900
150	G.E. S.B. Open	IK	720
125	G.E. TEFCBB	K	3600
125	A.C. B.B. Open	ARX-505	3600
125	West. S.S.B. Open New	CS-807	1800
125	G.E. S.B. Open	IK	1800
125	West. S.S.B. Open	CS	1800
125	El. Dyn. B.B. Drip.	KNX-22	1800
125	G.E. S.B. Open	KT-553	1200
125	G.E. S.B. Open	IK	1200
125	G.E. S.B. Open	IK	900
125	G.E. S.B. Open	IK	720
125	G.E. S.B. Open	IK	600
125	West. B.B. Open	CS-874C	600
100	Howell T.E.F.C.B.B.	K-505	3600
100	G.E. B.B. Drip	K-504	3600
100	G.E. S.B. Open	KT-343	1800
100	G.E.-B.B. Open.	K-504	1800
100	El. Dyn. T.E.F.C.B.B. XP	KNX-223	1800
100	L.A. T.E.F.C.B.B.	JX-113	1800
100	G.E. S.B. Open	KT-347	1200
100	West. SSB Open	CS-607	1200
100	Wagner T.E.F.C.B.B.	CP-635	1200
100	Reliance B.B. Drip.	AA-5084	1200
100	G.E. S.B. Open	KT-356	900
100	Al. Chal. T.E.F.C.B.B.	ARZX	900

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GUARANTEED "REBUILT" POWER EQUIPMENT

SQUIRREL CAGE MOTORS

3 phase, 60 cycle, 220 or 440 volts (2300 volts or higher)

H.P.	MAKE	TYPE	SPEED
1250	*Al.-Ch.	ANX	3600
600	West.	CS	720
600	*G.E.	K-63455	1200
500	*G.E.	K-63455	1200
500	*G.E.	I-13-E	900
350	*G.E.	KT-559-A	1800
300	*G.E.	K6344	1200
250	*W (TE)	CS-81205	1800
250	*G.E.	KT-509-S	1800
250	*West.	CS-875-S	1800
250	Brook	RS28	1200
200	*G.E.	FT-540	3600
200	*G.E.	I-K-13B	1800
200	West.	CSP-581-S	1800
200	Brook	RS-27	1200
200	*West.	CS-930-A	900
200	G.E.	KT-564-S	720
200	*Al.-Ch.	AN-37-G	720
200	*West.	CS-1010	600
200	Al.-Ch.	ARW-631	600
150	Cr-Wh	SC-140	3600
150	Al.-Ch.	AN 30-F	1200
150	West.	CSP-5815	1200

M.G. SETS

Kilowatt	Make	Volts AC	Volts DC
1000	West.	4000	250
750	G.E.	4160	275
500	West.	440	250
400	Al. Ch.	2300	240
300	West.	2300	250
200	G.E.	2300	275
200	Rdgwy	2300	250
150	Al. Ch.	2300	275
150	West.	2300	250
125	Cr. Wh.	4160	125
125	G.E.	2300	250
100	G.E.	2300	230
100	Al. Ch.	2300	60
60	G.E.	220/440	250
40	G.E.	220/440	250

HUNDREDS OF BARGAINS in MOTORS, GENERATORS, CONTROL, HOISTS, COMPRESSORS, ETC.

SLIP RING MOTORS

8 phase, 60 cycle, 220 or 440 volts (*2300 volts or higher)

H.P.	MAKE	TYPE	SPEED
2500	*G.E.	MT (Mill Type)	257
1100	*G.E.	MT	720
1000	*G.E.	M-575-S	1200
1000	*West.	CW	450
600	*G.E.	M-6345-S	1800
500	G.E.	M-6345	1200
400	*G.E.	MTP-585	1200
350	*Al.-Ch.	ARYW	1800
300	Cr-Wh	SR-70-R	1800
250	Al.-Ch.	ARY-626	1800
250	*G.E.	I-M-17A	720
200	G.E.	I-M-18	600
200	*West.	CW1950A	514
150	Cr-Wh	SR-50R	1800
150	G.E.	I-M-15A	600
125	G.E.	I-M-15A	600
100	G.E.	I-E-13A	1800
100	G.E.	MT558	720
100	G.E.	I-M-15A	425
75	West.	CW-770	1200

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3000 KW GE CURTIS. CONDENSING. 365# ISP. 200° FS 3/60/2300 VOLTS. NEW 1930. FULL AUXILIARIES. BARGAIN.

1666 HP BUSCH SULZER DIESEL. 8 CYL. 200 RPM. 1563 KVA WESTGHS. 3/60/2400 V. NEW 1938. FULL AUXILIARIES. EXCELLENT. REAL BARGAIN.

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70 CFM 1500 psi 9x8 Norwalk TDS3T
100 CFM 125 psi 6x7 Ing. ES1
138 CFM 100 psi 7x7 Ing. ES-1
140 CFM 3500 psi 12½x10 Norwalk TRS4T
182 CFM 120-500 psi 7½x13 Worth, St Booster
191 CFM 300 psi 9-4¼x9 CP TB2
238 CFM 100 psi 9x9 Worth. H. B. Ing ES
268 CFM 500 psi 10-4¼x10 Ing.
311 CFM 1500 psi 10½-7½-3½x13 Ing. ES3
465 CFM 100 psi 12x11 Ing.
502 CFM 125 psi 12x13 Worth. H.B.
585 CFM 100 psi 15-9¼x12 Ing. XRE 3-00-4160
628 CFM 100 psi 14x13 Ing ES
676 CFM 100 psi 15-9¼x12 Ing. XRB
868 CFM 125 psi 15-8x7 Joy WN102 150 HP 3-60-440 & starter
920 CFM 110 psi 18-11x12 CP-OCE
3852 CFM 100 psi 33—20½x24 Ing PRE2

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A. C. MOTORS—60 CYCLE

HP	Mfr.	Type	Volts	Speed
800	Whse. (2)	Sq. Cage	2300	1800
700	Whse.	Slipring	2300/4000	1200
600	Elliott (2)	Sq. Cage	2300	900
500	G.E.	Slipring	2300	900
500	Allis Ch.	Slipring	2300/440	600
400	Whse. (2)	Synch.	2200	1800
400	Whse.	Sq. Cage	2200	514
400	Marathon (2)	Sq. Cage	2300	2600
400	Whse.	Sq. Cage	2300	900
400	G.E.	Slipring	2300	514
350	Br. Boveri b.b.	Sq. Cage	4800/480	720
350	G.E.	Sq. Cage	2200	1800
350	G.E.	Slipring	440	1200
350	Allis Ch.	Slipring	2200/4000	600
350	G.E.	Slipring	220/440	900
300	G.E.	Slipring	2200/440	600
300	G.E. (2)	Synch.	2200/440	360
300	Whse.	Slipring	2300	514
300	Whse.	Synch.	440	1200
250	G.E.	Sq. Cage	2200/440	1200
250	Gen. Elec.	Sq. Cage	440	3600
250	G.E.	Sq. Cage	2200	1800
250	Whse.	Sq. Cage	2300/440	600
200	G.E.	Slipring	440	600
200	L.A. TEFC	Sq. Cage	440	1200
200	G.E.	Slipring	2200	900
200	Reliance b.b.	Sq. Cage	220/440	1800
200	Allis Ch.	Slipring	440	450
200	Allis Ch.	Slipring	2200/440	720
200	Whse.	Sq. Cage	2200/440	900
150	Rel TEFC	Sq. Cage	220/440	900
150	G.E. (4)	Slipring	2200/440	600
150	Cr. Wheeler	Sq. Cage	220/440	450
150	G.E. (2)	Sq. Cage	2200.440	1800
150	Whse.	Slipring	220/440	1200
150	G.E.	Sq. Cage	2300	900
125	F.M. b.b. (2)	Sq. Cage	220/440	1800
125	El. Machy. (2)	Synch.	220/440	400
125	G.E. T.E.F.C.	Sq. Cage	2200	3600
125	Al. Ch. TEFC	Sq. Cage	220/440	600
75	G.E. b.b. (8)	Sq. Cage	220/440	1200

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
200	Gen. Elec.	HC	250	1450
150	Whse.	SK-184	250	1150
150	Cr. Wh.	CCD	250	650
100	Cr. Wh.	CCD-65H	125	1200
75	Gen. Elec.	CD-123	125/250	1200
75	Whse. b.b.	SK-123L	250	1800
60	Ideal	D	125	1150
60	Reliance b.b.	262-T	250	1200
40	Reliance b.b.	230-T	250	1200

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
250	Cr. Wh.	101-H	230	1150
200	G.E. (2)	RC-38	230	1150
200	Whse. b.b.	SK	250	287/575
150	Whse.	SK-184	230	850
150	Whse.	SK-210	230	320/1000
150	G.E. b.b. dyn.	TLC-50	250	1750/3500
125	G.E.	CD-173	230	575/1150
100	Elliott b.b. T.E.	JH-FE	230	1150
75	Whse.	SK-163	230	850
75	Whse. (4)	SK-163	230	500/1500
60	G.E. TEFC b.b.	CD-135	230	1150
50	Century	DN-314	220	1150/1750
50	G.E.	RF-16	230	250/1000
40	Whse. b.b. (2)	SK-163	230	300/1200
25	Whse. (2)	SK-153	230	300/1200

MOTOR-GENERATOR SETS

KW	Mfr.	Input V	Output V
600	Allis Ch.	440 AC	250 DC
300	Whse. (2)	2200/440 AC	250 DC
200	Gen. Elec.*	220/440 AC	125 DC
125	Gen. Elec.*	2300/4000 AC	250 DC
100	Gen. Elec.	220/440 AC	250 DC
75	Star b.b.	220/440 AC	250 DC
75	G.E.	200/440 AC	125 DC
60	Allis Ch.	220/440 AC	250 DC
50	Cr. Wh. b.b. (2)	220/440 AC	250 DC
40	Ideal	220/440 AC	250 DC

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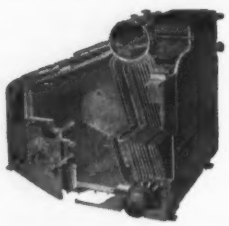

# Steam/hr.	Key	PSI	Temp.
122,500	DF	565	850
121,650	DF	565	850
60,000	SF	435	750
74,000	H	280	500
55,000	A	240	—

DF Double Furnace, SF Single Furnace (illustrated), bent water tube boilers w/economizers and superheaters, B & W's and Foster Wheelers.

H Header type, straight tube, B & W.

A 3 drum, single furnace, Wickes.

Polnik-Loconti Industrial Supply Co.
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Utica, N. Y. Ph. RE 6-4621, RE 2-4513

1500 HP D.C. MOTORS

1500 HP—525 volts D.C.—600 R.P.M.—NEW—2-bearing continuous duty motors—manufactured by Westinghouse. In original crates. From Navy Destroyer Escort. SPECIFICATIONS: 2-bearing 1500 HP—525 volts DC—2270 amps—600 RPM—ambient temperature 40C—class B insulation—2-bearing pedestal sleeve type—shunt wound—efficiency 94.23% ONLY 6 AVAILABLE—BUY NOW AND SAVE. Suitable for steel mill drive—offshore oil rigs—rolling mill drive—dredge pump applications.

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ELGIN 5-5050 LEXINGTON 9-1900

FOR SALE

240 Ton Twin York AMMONIA COMPRESSOR (120 ton each)

8 Cylinder, Driven by De Laval turbine, 400 H.P., 140 lb. steam—30 lb back pressure, 4540 RPM, thru double shaft helical reduction gears 720 RPM. NEW 1951.

J. L. HEMPHILL & CO.
1603 54th Street, North Bergen, N.J.
Union 3-2600

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Diesel Generator Units, 200 KW-1500 KW — Turbo Generators, 500 KW-10,000 KW
Motor Generator Sets—Rotary Converters—Synchronous Condensers—
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2/59

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DUAL FUEL & DIESEL ENGINE GENERATOR UNITS

1750 KVA Nordberg supercharged dual fuel engine generator unit 3 phase 60 cycle 2400 volts.

1250 KVA Worthington supercharged dual fuel engine generator unit 2400/600/480 volts.

1250 KVA (2) Worthington supercharged diesel engine generator units 3 phase 60 cycle 2400/600/480 volts.

1000 KVA Nordberg supercharged diesel engine generator unit 3 phase 60 cycle 2400 volts.

INTERNATIONAL POWER MACHINERY CO.
1612 Union Commerce Bldg. — MAin 1-9514
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FOR SALE
14 NEW TURBINES

4 horizontal, 10 vertical, Westinghouse Driving forced draft blowers—capacities ranging from 39000 to 56000 CFM and 16" to 24" pressure. Steam pressures 360 to 575#, back pressure 10#.

Will sell turbines separately if desired.

Price reasonable.

Also—1—250 KW GE turbo generator unit, 3 phase, 60 cycle, 440 volt. Used one year.

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2457 WOODWARD AVE.
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HI-PRESSURE

Complete stock from 10-2,000 h.p.
Nation's largest inventory, New & Used
WABASH POWER EQUIPMENT CO.
9750 Skokie Blvd., Chicago (Skokie) Ill. OR 5-8118

Complete Switchboard Design and Construction
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Advertisers' Index

A

Aerotec Corp. ..... *
Air Preheater Corp. 163
Alco Products, Inc. ..... *
Allen-Sherman-Hoff Co. ..... *
Allgemeine Elektricitats-Gesellschaft ..... Second Cover
Allied Metal Hose Co. ..... *
Allis-Chalmers Mfg. Co. 54
Allpax Company, Inc. 100
Aluminum Company of America ..... *
American Blower Div. ..... *
American Gilsonite Co. ..... *
American Hard Rubber Co. ..... *
American Pulverizer Co. 148
American Standard Industrial Div. 149
Ames Iron Works 93
Anchor Packing Co. 89
Armstrong Machine Works 85

B

Babbitt Steam Specialty Co. 162
Babcock & Wilcox Co. 4-5
Badger Mfg. Co. 133
Bailey Meter Company 10-11
Baldwin-Hill Co. ..... *
Baltimore & Ohio Railroad ..... Third Cover
Barber-Colman Co. ..... *
Barnes & Jones, Inc. ..... *
Bell & Gossett Co. ..... *
Belmont Packing & Rubber Co. ..... *
Bergen Pipesupport Corp. ..... *
Betz Laboratories, Inc. ..... *
Biddle Co., James G. ..... *
Bingham Pump Co. 136
Bituminous Coal Institute ..... *
Black, Sivalls & Bryson, Inc. 113
Blaw-Knox Co., Equipment Div. 157
Blaw-Knox Co., Power Piping & Sprinkler Div. ..... *
Boiler Tube Co. of America ..... *
Bonney Forge & Tool Works 106
Borg-Warner Mechanical Seals Div. of Borg-Warner Corp. ..... *
Breuer Electric Mfg. Co. ..... *
Bridgeport Brass Co. 99
Buell Engineering Co. 160
Buffalo Forge Co. 18-19
Buffalo Pumps, Inc. ..... *
Bussmann Mfg. Co. 52-53
Byron Jackson Pumps Inc. ..... *

C

Calgon Company ..... *
Carpenter Steel Co., Alloy Tube Div. ..... *
Catawissa Valve & Fittings Co. ..... *
Chapman Valve Mfg. Co. ..... *
Chase Brass & Copper Co. 181
Chemicals & Materials Corp. 130
Chesterton Co., A. W. 128
Chicago Pneumatic Tool Co. ..... *
Clarage Fan Co. 40
Cleaver-Brooks Co., Boiler Div. ..... *
Clyde Iron Works, Inc. ..... *
Cochrane Corporation 127
Combustion Engineering, Inc. 26-27
Condenser Service & Engrg. Co. ..... *
Cooper-Bessemer Corp. ..... *
Copes-Vulcan Div., Blaw-Knox Company 12-13
Coppus Engineering Corp. 111
Corning Glass Works ..... *
Crane Company 115
Crawford Fitting Co. 218

D

Deady Chemical Co. ..... *
Dearborn Chemical Co. ..... *
DeLaval Separator Co. ..... *
DeLaval Steam Turbine Co. 166, 167
Detroit Controls Div. of Amer. Standard ..... *
Detroit Stoker Co. 97
Diamond Power Specialty Corp. 6-7
Dodge Mfg. Corp. ..... *
Dow Chemical Co. ..... *
Dow Corning Corp. ..... *
Dowell Inc. ..... *
Dravo Corporation ..... *

E

Eagle-Picher Company ..... *
Earle Gear & Machine Co. ..... *
Edward Valves, Inc. 22-23
Electric Machinery Mfg. Co. ..... *
Elgin Softener Corp. 138
Elliott Company 14-15
Elliott Company—Lagonda Plant 158
Elliott Company—Roto Plant 110
Engineer Company 134
Erie City Iron Works 125

F

Fairbanks Company 180
Fibreboard Paper Products Corp., Pabco Ind. Insulations Div. ..... *
Fisher Governor Co. 108, 109
Flanders Filters, Inc. ..... *
Fluor Products Co. ..... *
Fly Ash Arrestor Corp. 132
Foster Wheeler Corp. ..... *
Foxboro Company 42-43
Frick Company 176
Fuller Company ..... *

G

Garlock Packing Company 174
Gates Rubber Co. ..... *
General Electric Co., Apparatus Dept. ..... *
Goulds Pumps, Inc. 179
Green Fuel Economizer Co. 47
Grinnell Company 171
Griscom-Russell Co. 159

H

Hagan Chemical & Controls, Inc. 88
Hall Laboratories ..... *
Hamon, Inc. ..... *
Harbison-Walker Refractories Co. 24-25
Hartman-Walsh 209
Hays Corporation ..... *
Heyl & Patterson, Inc. ..... *
Hoffman Specialty Mfg. Corp. ..... *

I

I-T-E Circuit Breaker Co. R & IE Equipment Div. ..... *
I-T-E Circuit Breaker Co. Switchgear Div. ..... *
Ideal Electric & Mfg. Co. ..... *
Illinois Water Treatment Co. ..... *
Infilco Inc. 169
Ingersoll-Rand Co. 121
International Heating & Air Conditioning Exposition ..... *
International Nickel Co., Inc. 32
International Register Co. Instrument Div. 124
Iron Fireman Mfg. Co. ..... *

J

Jeffrey Mfg. Co. ..... *
Jenkins Bros. 87
Jerguson Gage & Valve Co. 167
Johns-Manville 8-9
Johnson Service Co. 38-39
Jones & Laughlin Steel Corp. 50

K

Kato Engineering Co. 182
Keasbey & Mattison Co. ..... *
Keeler Co., E. ..... *
Kieley & Mueller, Inc. 129
Kirk & Blum Mfg. Co. 96
Klipfel Valves, Inc. ..... *
Koppers Co., Inc. Aeromaster Fan Dept. ..... *
Koppers Co., Inc. Coupling Dept. ..... *
Koppers Co., Inc. Electrostatic Precipitators Dept. 30

L

Laclede Stoker Co. ..... *
Ladish Company 137
Leslie Company ..... *
Limitorque Corp. ..... *
Link-Belt Company 1
Lukens Steel Co. ..... *
Lunkhenheimer Co. ..... *

M

Manning, Maxwell & Moore, Inc. ..... *
Marley Company 37
Marsh Instrument Co. ..... *
Maryland Shipbuilding & Drydock Co. ..... *
McDonnell & Miller, Inc. 168
McGraw-Hill Book Co. ..... *
McNally-Pittsburg Mfg. Corp. 170
Mesta Machine Co. ..... *
Midwest Piping Co., Inc. 123
Minneapolis-Honeywell 161
Murray Iron Works Co. 45
Murray Mfg. Co., D. J. 162

N

National Airoil Burner Co., Inc. ..... *
National Aluminate Corp. 135
National Conveyors Co., Inc. ..... *
National Tube Div. of U. S. Steel 175
Niagara Blower Co. ..... *
Nicholson & Co., W. H. 188
Nordberg Mfg. Co. 187
North American Mogul Prods. Co. ..... *
Nuclear Products Co. ..... *

This index is a service to readers. Every effort is made to maintain its accuracy, but POWER cannot assume responsibility for errors or omissions. When a star appears after the name, the advertisement does not appear in this issue but appeared in an issue within the previous three months.

O

Ohio Brass Company ... *
Ohio Injector Company ... *
Orr & Sembower, Inc. ... *

P

Panellit, Inc. ... *
Patterson-Kelley Co. ... 91
Peabody Engrg. Corp. ... *
Peerless Pump Div., Food Machy. & Chemical Corp. ... 143
Pelton Div., Baldwin-Lima-Hamilton ... *
Pennsylvania Flexible Metallic Tubing Co. 109
Permutit Company ... *
Phelps-Dodge Copper Products Corp. ... *
Philadelphia Gear Corp. ... 185
Phoenix Mfg. Co. ... *
Pioneer Service & Engineering Co. ... 112
Pipe Fabrication Institute ... *
Pittsburgh Piping & Equipment Co. ... *
Porter Co., Inc., H. K. Forge & Fittings Div. ... *
Powell Co., Wm. ... 177
Pritchard & Co., J. F. ... *

R

R-P & C Valve Div., Amer. Chain & Cable Co., Inc. ... *
Raybestos-Manhattan, Inc. Manhattan Rubber Div. ... 20-21
Raybestos-Manhattan, Inc. Packing Div. ... 184
Reliance Gauge Column Co. ... 172
Republic Flow Meters Co. ... 28-29
Republic Steel Corp., Steel & Tubes Div. ... *
Research-Cottrell, Inc. ... 140-141
Ric-Wil Incorporated ... *
Ridge Tool Company ... 98
Riley Stoker Corporation ... 78-79
Robertshaw-Fulton Controls Co. Aeronautical & Instrument Div. ... 122
Rohm & Haas Co. ... 147
Ross Heat Exchange Div. ... *

S

Sarco Company, Inc. ... 90
Schaub Engrg. Co., Fred H. ... *
Scovill Mfg. Co. ... *
Sheraton Corp. of America ... 139
Sinclair Refining Co. ... *
Smith Company, S. Morgan ... *
Smith Corp., A. O. ... 182
Socony Mobil Oil Co. ... 83
Southwestern Engineering Co. ... *
Standard Oil Co. of Indiana ... 107
Stickle Steam Specialties Co. ... 120
Superior Combustion Industries, Inc. ... 105

T

Taylor Instruments Companies ... 48-49
Terry Steam Turbine Co. ... 173
Texas Company ... *
Titusville Iron Works Co. Div. of Struthers Wells ... 119
Tube-Turns Division of Chemetron Corp. *

U

Union Asbestos & Rubber Co. ... *
Union Iron Works ... *
United States Gauge ... 178
United States Motors Corp. ... 134
Universal Atlas Cement Div. of U.S. Steel ... 92

V

Viking Pump Co. ... *
Virginia Gear & Machine Corp. ... 185
Vogt Machine Company, Henry ... 131

W

Wallace & Tiernan, Inc. ... 156
Walworth Company ... 183
Warren Pumps, Inc. ... *
Western Chemical Co. ... *
Western Precipitation Corp. ... *
Westinghouse Electric Corp. ... 46
Westinghouse Electric Corp. Sturtevant Div. ... *
Wheeler Mfg. Co., C. H. ... 155
Where to Buy ... 209
Whiton Machine Company ... 126
Wickes Boiler Co. ... 31
Wiedeke Co., Gustav ... 122
Wolverine Tube Div. of Calumet & Hecla, Inc. ... 41
Worthington Corp. ... Back Cover

Y

Yarnall-Waring Company ... 16-17, 81, 120
Yuba Heat Transfer Div. ... *

Z

Zallea Brothers ... *
Ziegler Co., G. S. ... 44

Professional Services ... 209

CLASSIFIED ADVERTISING

F. J. Eberle, Business Mgr.

EMPLOYMENT OPPORTUNITIES ... 210

SPECIAL SERVICES
Contract Work ... 210

EDUCATIONAL
Books ... 210

BUSINESS OPPORTUNITIES ... 210

EQUIPMENT
(Used or Surplus New)
For Sale ... 210-215

WANTED
Equipment ... 210

ADVERTISERS INDEX

Ajax Electric Motor Corp. ... 210
Alco Products Incorporated ... 210
Allied Electric & Machinery Co. ... 210
American Air Compressor Corp. ... 213
Anderson Company, Lars ... 215
Anthony Company, W. S. ... 210

Belyea Company, Inc. ... 212
Benson-Wilimzig, Inc. ... 213
Boston Metals Company, The ... 214
Brew-Woltman & Co., Inc. ... 212

Campbell & Company, Ltd., C. R. ... 215
Chicago Electric Company ... 213

DeRose, G. M. ... 215

Ebasco Services Inc. ... 210-215

Hall & Company, Stephen ... 212
Heat & Power Company, Inc. ... 213
H & P Machinery Company ... 213
Heller, Albert ... 215
Hemphill & Company, J. L. ... 212-214

Industrial Motor Service ... 215
International Power Machinery Co. ... 215

Jeff-Connors Company ... 215

Lefax ... 210

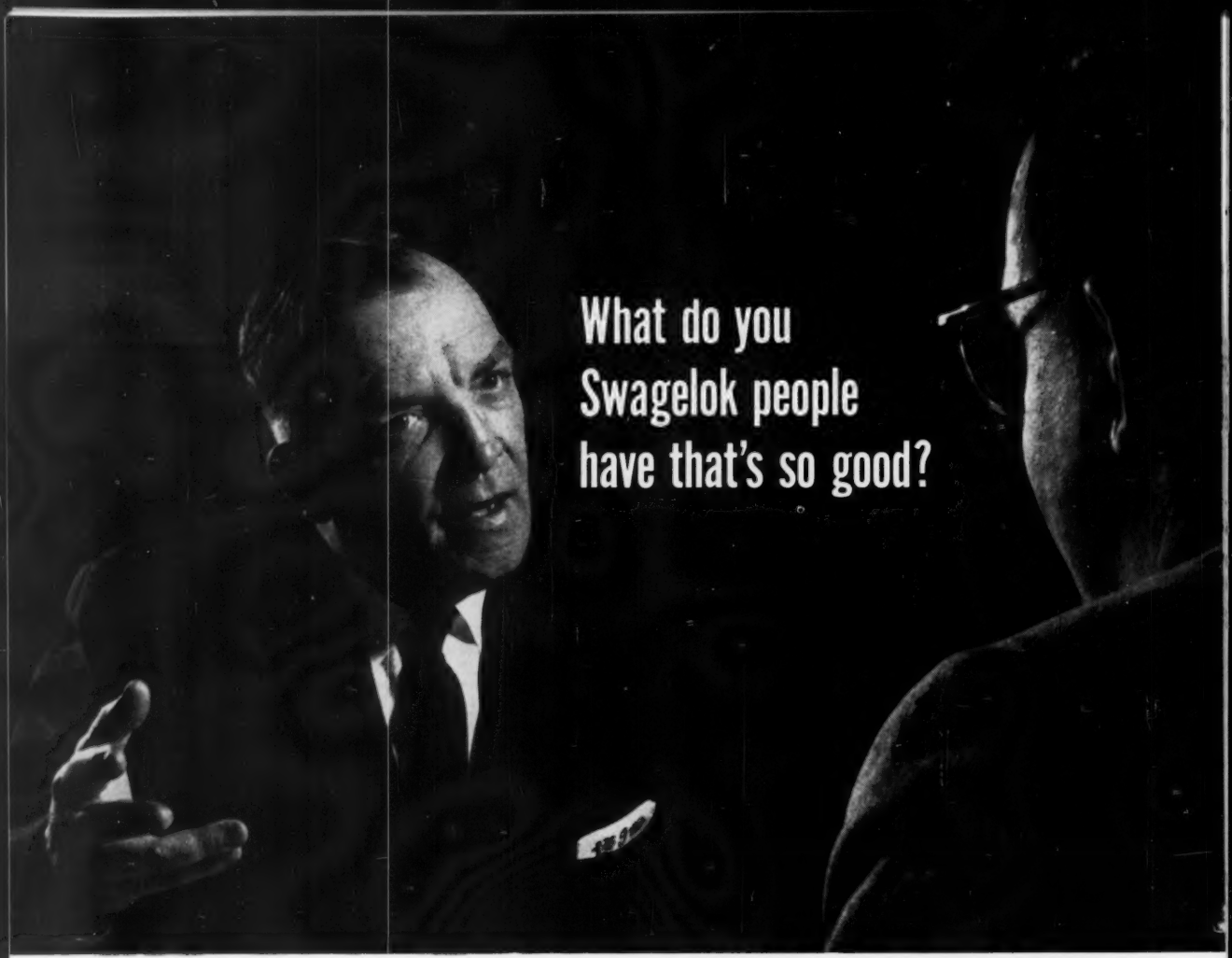
Midwest Boiler & Turbine Company ... 215
Monarch Personnel ... 210

Oberman, Paul ... 210

Pelnik-Loconti Industrial Supply Co. ... 214
Perry Equipment Corp. ... 212
Power Equipment Company ... 213

Universal Power & Engineering Co. ... 215
Utilities Machinery Corp. ... 214

Wabash Power Equipment Co. ... 215
Wagner Company, Arthur ... 214
Weaver, Inc., Charles ... 211
Whisler Equipment Company ... 213



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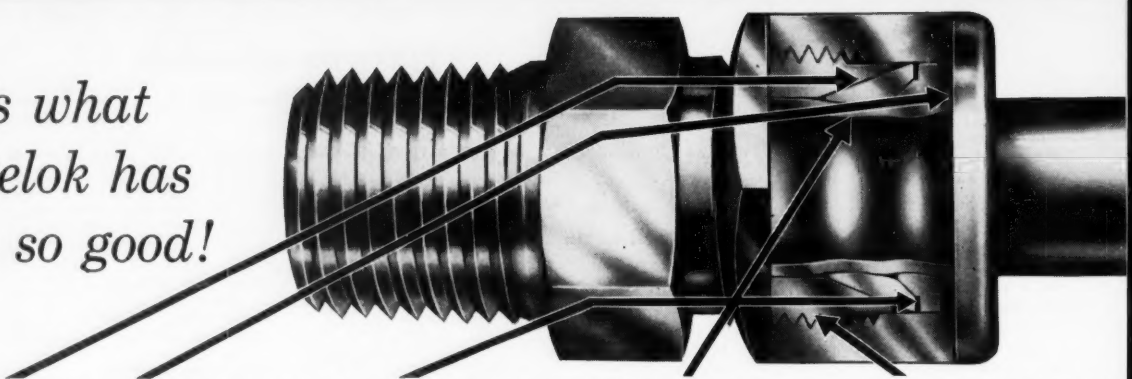

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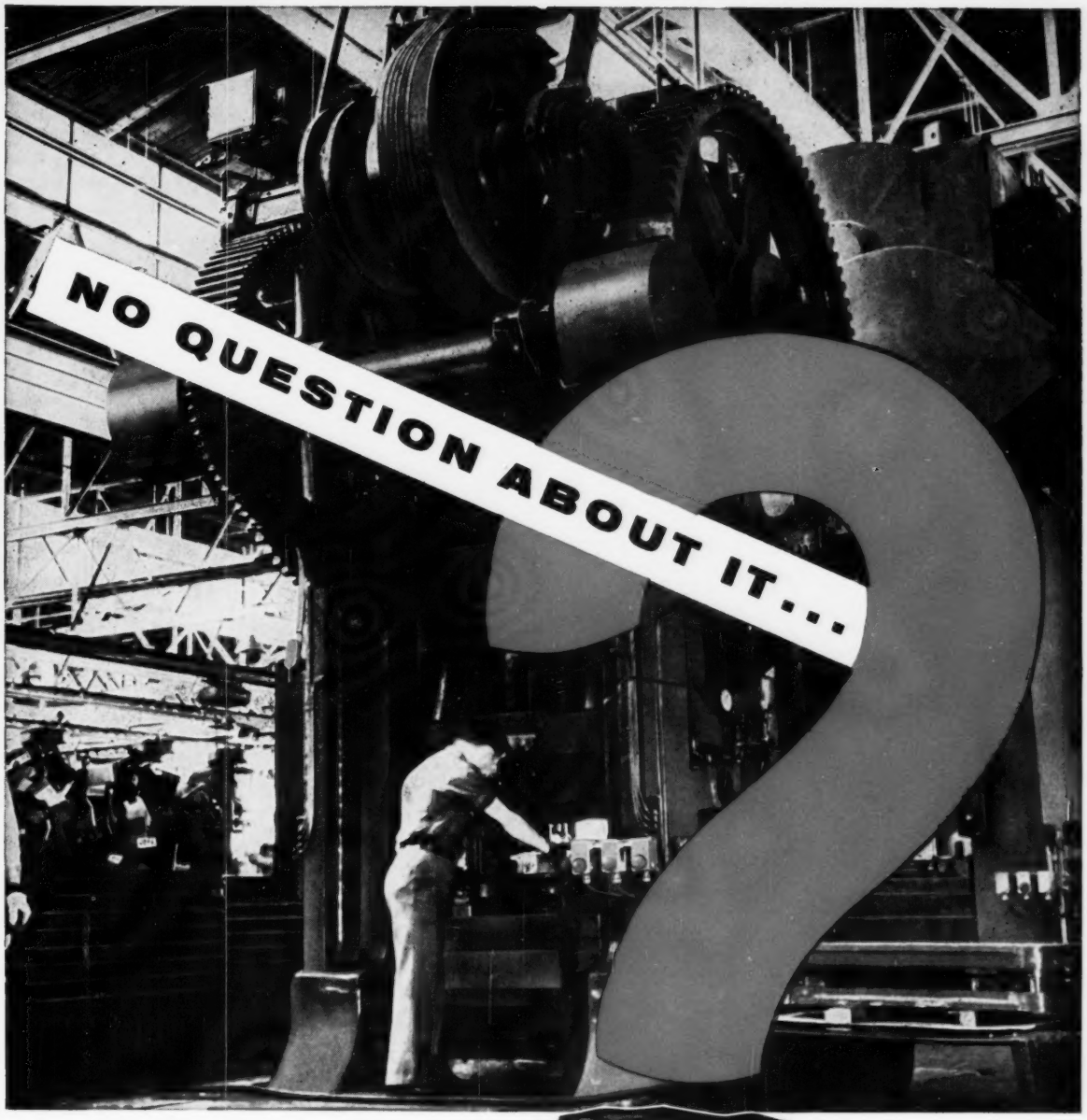
For more facts circle 321 on Reader Service Card, p 102



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NUCLEAR NEWSLETTER FROM WORTHINGTON

Progress Report on nuclear activities at Worthington, including work on primary and secondary cycle equipment, packaged power plants for the military, equipment for both Navy and commercial ships, and central station power plants:

Water-lubricated bearings used in primary circuits of nuclear power plants are now proven. Exhaustive tests up to 12,000 rpm were recently concluded successfully. Work now under way on turbine-driven units, will completely eliminate oil contamination in reactor systems.

Self-contained "packaged" power reactor designed to operate continuously for 3 years with a single fuel loading has a Worthington turbine generator. Known as the Argonne Low Power Reactor, the 300 kw geared unit is in a prototype plant for use in remote areas.

Add to Worthington "firsts" installation of the world's largest steam condenser especially designed for nuclear power. Location is the Commonwealth Edison Company's Dresden Nuclear Power Plant near Chicago. The 120,000 sq. ft. unit will condense over a million and a half pounds of steam per hour, use 25 million gallons of water per day for the free world's first all privately financed atomic reactor.

Polaris Program: Worthington is furnishing all high-pressure compressors for this recent crash program. Polaris is the name given to the Navy's top-priority ballistic missile carrying nuclear submarine project.

U.S.S. Savannah (first nuclear merchant vessel) will go to sea with Worthington reactor system charging pumps, many other items of secondary cycle and ship's equipment.

Participation in informal study groups with reactor builders, architect-engineers and government agencies has added to Worthington's nuclear "know how". From these studies come improvements in products and cycles, new basic ideas.

Production experience has resulted in a new article on the *Art of Manufacturing Nuclear Components.* Now published, a copy is yours simply by writing: Worthington Corporation, Section 106-1, Harrison, New Jersey.